TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED SIX

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-fifth Annual Meeting

JULY 24, 25 AND 26, 1906,

At Grand Rapids, Michigan.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS,
1906.

Officers for 1906-1907.

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Vice-President.....H. M. SMITH, Washington, D. C.

Recording Secretary.....GEORGE F. PEABODY, Appleton, Wis.

Corresponding Secretary, CHARLES G. ATKINS, East Orland, Me.

Treasurer.....C. W. WILLARD, Westerly, R. I.

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S. F. FULLERTON, St. Paul, Minn.

AMERICAN FISHERIES SOCIETY.

Organized December, 1870.

PRESIDENTS.

1.	William Clift	1870-1871
2.	William Clift	1871-1872
3.	William Clift	1872-1873
4.	Robert B. Roosevelt	1873-1874
5.	Robert B. Roosevelt	1874-1875
6.	Robert B. Roosevelt	1875-1876
7.	Robert B. Roosevelt	1876-1877
8.	Robert B. Roosevelt	1877-1878
9.	Robert B. Roosevelt	1878-1879
10.	Robert B. Roosevelt	1879-1880
11.	Robert B. Roosevelt	1880-1881
12.	Robert B. Roosevelt	1881-1882
13.	George Shepard Page	1882-1883
14.	James Benkard	1883-1884
15.	Theodore Lyman	1884-1885
16.	Marshall McDonald	1885-1886
17.	W. M. Hudson	1886-1887
18.	William L. May	1887-1888
19.	John H. Bissell	1888-1889
20.	Eugene G. Blackford	1889-1890
21.	Eugene G. Blackford	1890-1891
22.	James A. Henshall	1891-1892
23.	Herschel Whitaker	1892-1893
24.	Henry C. Ford	1893-1894
25.	William L. May	1894-1895
26.	L. D. Huntington	1895-1896
27.	Herschel Whitaker	1896-1897
28.	William L. May	1897-1898
29.	George F. Peabody	1898-1899
30.	John W. Titcomb	1899-1900
31.	F. B. Dickerson	1900-1901
32.	E. E. Bryant	1901-1902
33.	George M. Bowers	1902-1903
34.	Frank N. Clark	1903-1904
35.	Henry T. Root	1904-1905
36.	C. D. Joslyn	1905-1906
37.	E. A. Birge	1906-1907

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PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, July 24, 1906.

Convention called to order at 12 m. by the President, Mr. C. D. Joslyn, of Detroit, Michigan, at the Board of Trade Building, Grand Rapids, Michigan.

President: Gentlemen of the American Fisheries Society, I take pleasure in calling you to order for the thirty-fifth meeting of this society. This is not the time nor the occasion for a speech from your president. We have quite a large membership and quite a large number present in the city. The incoming trains are just about due now and will bring probably quite an addition to our numbers, but I have thought, in view of the fact that we have some guests present and we have the mayor of the city of Grand Rapids from whom we wish to hear, that I would call you to order at this time without waiting for the members who will be in here later.

Last year I think those of us who met with you at White Sulphur Springs told you that if you would come to Grand Rapids you would never be sorry, and I may say to you now that the city of Grand Rapids is one of the very best in the country. As the Hon. James G. Blaine once said, it is the largest city for its size that there is in the country. Its hospitality is unbounded, and as soon as the citizens of this city knew that we were to meet here they were only anxious to know what we wanted them to do, and they have showered honors and invitations upon us, some of which we will not be able to accept, and do business at the same time. They would entertain us during the three days that we were here, and not give us a chance to work at all if we would let them. We have with us here, as usual, our old and honored friend, our ex-president, Mr. Root. Long may he live and meet with us! We have probably the most con-

venient man in the country also with us, our treasurer, Mr. Willard, who pays the bills and debts of the society and trusts to us to reimburse him later on. (Great laughter and applause.) We also have with us as usual, our secretary, Mr. Peabody, who does all the work in preparing for these meetings and gets out the reports afterwards; then, of course, the president takes the credit for the entire job. (Applause.) I might go on and mention the familiar faces that we see here, but it is not necessary; it is good to see all these familiar faces again.

I now take pleasure, gentlemen, in introducing to you the mayor of Grand Rapids, Mr. Ellis, who will welcome you.

Mr. George E. Ellis of Grand Rapids: Mr. President and gentlemen, it is surely a great pleasure to say to you a few words just now, although at this particular hour I know that you do not expect very much. It is a good deal like a man who was invited to talk to a Sunday school class and he said: "Now, children what would you rather I would talk about." One of them said: "We would rather you would talk about a minute." (Laughter.) I guess that is about the way it is now, as it is so nearly your luncheon hour.

Your president is feeling especially good today. He was telling of a little incident that happened to him in Detroit the other day. He came down town and he told how well he felt. He said, "I feel better than I have for a long while, because my wife thinks I am such a good man. Why, this morning before I came down she told me that I was a model husband." So he told that to two or three people, and he was so pleased that he finally met his pastor and he told him about it. And he said, "Mr. Joslyn, before you tell that to many more people you better look in the dictionary and find out what 'model' means, and then you will learn just what kind of a husband you are." So he looked in the dictionary and found out that a 'model' was 'a small imitation of the real thing.' (Laughter.)

Now we are greatly pleased to see you here, and while you are in the city there will be no closed season, and you can go in any part that you want, and I will guarantee in this metropolitan city that, no matter what your desires and tastes are, you can gratify them, (laughter and applause) and if you do not find

it with ease, I see the four gentlemen here who represent the Grand Rapids committee and I will guarantee they can tell you very easily where it is, because they have been there themselves. (Laughter.) Mr. Adams, who was going to speak a few words to you, had a dream the other day, and he dreamt that he had got into heaven, strange as it may seem, and he told his wife how he had trod the streets of the New Jerusalem and what great sights he saw; and she said, "Fred, if you ever got into such a nice place as that, what made you get out?" "Why," he said, "the heat woke me up!" (Laughter.) Now, no matter how hot or cold it is, it is always good weather when good fellows are together, and if there are any people who are good fellows and enjoy associating together, it is the fishermen; you will make more lasting friendships when you are fishing or hunting than in any other line that I can recall, and in that it reminds me of a little saying on old friends which I will give you.

"Make new friends but keep the old,
For the new are silver but the old are gold.
New-made friends like new-made wine,
With age may mellow and refine.
Unlike old age with hair so gray,
True friendship never can decay.
So make new friends but keep the old,
For the new are silver but the old are gold." (Applause.)

President: Before we go to our lunch, gentlemen, I want to say to you that they have a real sportsman's association here in Grand Rapids, with all that that implies. That being so, I desire to call on the president of that association to say a few words of welcome to us. I should be very glad to have him come forward.

Mr. Otis A. Felger of Grand Rapids: The president is here under promise from me that under no circumstances would he be called upon, and he has engaged as his substitute, Mr. W. R. Shelby. He is not the president but a very active and honored member.

Mr. W. R. Shelby of Grand Rapids: Mr. President and Gentlemen of the American Fisheries Society: The gentleman introducing me to welcome you on behalf of the Consolidated

Sportsmen's Club of Grand Rapids says its President cannot make a speech, thus intimating that I can. I will say that while President Felger is too diffident to talk he is one of the finest shots in Michigan and takes pleasure in trying to teach me how to shoot, so that I am pleased to do some one thing better than he can. While not professing to be a public speaker I am inspired by the eloquence of your President and our Mayor, who preceded me, to say, that we are glad your Society has come to Grand Rapids to hold its annual meeting. I am connected with the Grand Rapids & Indiana Railway Company, which has always taken great interest and done much for the propagation of fish in Michigan and we welcome any effort to increase and maintain the finny tribe in our waters. The people of Grand Rapids and Michigan would be astonished and pleased to know the wealth the State gains by her fisheries; to know the number of people who come into the state only because it is a place to fish and because it has the "Fishing Line" to bring them. Tourists coming to Michigan to fish do not have to be told "when they go to a certain place that they should have gone over to the other place." They can catch fish anywhere in our rivers and lakes.

Our Mayor calls attention to "This being your noon hour" and I will not detain you longer because after becoming better acquainted with you, will be able to talk more interestingly to you, but on behalf of the Sportsmen's Club I welcome you to Grand Rapids and hope your visit will be pleasant and the object of your Society materially advanced by your presence and stay among us.

The registered attendance at the meeting of the society is as follows:

Alford, Jabe, *Madison, Wis.*
Atkins, Chas. G., *East Orland, Maine.*
Avery, Charles, *Hutchinson, Minn.*

Bartlett, S. P., *Quincy, Ill.*
Bassett, C. R., *Paw Paw, Mich.*
Bean, Tarleton H., *New York City.*
Birge, E. A., *Madison, Wis.*
Boardman, W. H., *Central Falls, R. I.*
Bower, Seymour, *Detroit, Mich.*

Bower, Ward T., *Northville, Mich.*
Brass, J. L., *Drayton Plains, Mich.*
Brewer, E. S., *Owosso, Mich.*
Brown, George M., *Detroit, Mich.*

Carter, George L., *Lincoln, Neb.*
Clark, Frank N., *Northville, Mich.*
Clark, Fred, *Mill Creek, Mich.*
Cutler, William, *Mill Creek, Mich.*

Dean, H. D., *Neosho, Mo.*
Dickinson, G. C., *Harrietta, Mich.*

Filkins, B. G., *Northville, Mich.*
Fullerton, Sam F., *St. Paul, Minn.*

Gunckel, John E., *Toledo, Ohio.*

Hankinson, T. L., *Charleston, Ill.*
Hogan, J. J., *La Crosse, Wis.*
Hughes, Wm. H., *St. Louis, Mo.*

Johnson, R. S., *Manchester, Iowa.*

Lydell, Dwight, *Mill Creek, Mich.*

Marks, J. P., *Paris, Mich.*
Meehan, W. E., *Harrisburg, Pa.*
Monroe, Otis, *Mill Creek, Mich.*
Monroe, Wm., *Mill Creek, Mich.*
Morcher, George, *London, Ohio.*
Morton, William P., *Providence, R. I.*

Nevin, James, *Madison, Wis.*

O'Brien, W. J., *South Bend, Nebraska.*

Peabody, George F., *Appleton, Wis.*
Porter, Richard, *Paris, Mo.*

Reighard, J. E., *Ann Arbor, Mich.*
Roberts, A. D., *Woonsocket, R. I.*
Root, Henry T., *Providence, R. I.*
Rosenbery, Albert, *Kalamazoo, Mich.*

Shortal, J. M., *906 Chestnut St., St. Louis, Mo.*

Thayer, W. W., *Detroit, Mich.*
Titcomb, Jno. W., *Washington, D. C.*

Whish, John D., *Albany, N. Y.*
Willard, C. W., *Westerly, R. I.*
Wires, S. P., *Duluth, Mich.*

Zalsman, Phil. G., *Paris, Mich.*

Registered attendance of Visitors:

Adams, Fred J., Editor, *Grand Rapids, Mich.*

Ellis, George E., Mayor, *Grand Rapids, Mich.*

Felger, Otis A., *Grand Rapids, Mich.*

Roth, Prof. Filibert, *Ann Arbor, Mich.*

Shelby, W. R., *Grand Rapids, Mich., Vice President Grand Rapids & Indiana Railway Co.*

The treasurer then presented his report as follows:

To the American Fisheries Society of the United States of America.

Gentlemen:—I herewith submit my annual report as Treasurer from July 25, 1905, to July 24, 1906:

RECEIPTS.

1905.		
Life membership fees	$ 60.00	
Yearly dues	647.10	
Sale of reports	25.30	
		$732.40

EXPENDITURES.

July 25—Balance due Treasurer	$111.87	
July 27—C. G. Atkins, printing	2.66	
Aug. 29—Stamped envelopes	10.70	
Sept. 18—Murray Lyceum Bureau, stereopticon	4.25	
Oct. 7—A. H. Dinsmore, stereopticon	5.00	
Oct. 10—One letter file	.35	
Nov. 6—Stamped envelopes	10.70	
Dec. 22—Telegram to Geo. F. Peabody, Secretary	.70	
Dec. 23—Typewriting	1.25	
Dec. 23—H. D. Goodwin, stenographer	202.00	
1906.		
Mar. 15—Post Publishing Co., reports	289.15	
Mar. 15—G. F. Peabody, Sec'y, mailing reports, etc	74.85	
Apr. 14—Gibson Bros., circulars	3.15	
July 11—Stamped envelopes	10.70	
July 17—Post Publishing Co., circulars, etc	15.50	
July 17—Geo. F. Peabody, Sec'y, stamps, etc	16.35	
	$759.18	
July 24—Balance due Treasurer		$ 26.78
		$759.18

Respectfully submitted,
C. W. WILLARD, Treasurer.

Motion made, seconded and unanimously carried, that the report be referred to auditing committee.

President: I will appoint as members of the committee Mr. Geo. M. Brown, Mr. R. S. Johnson, and Mr. A. D. Roberts.

The following is a list of applicants for membership in the association, made since the last meeting:

Alford, Jabe, *Fish Commissioner, Wis., Madison, Wis.* (Proposed by E. A. Birge.)

Avery, Charles, *Minnesota Fish and Game Commission, Hutchinson, Minn.* (Proposed by Samuel F. Fullerton.)

Bassett, C. R., *Glen Springs Trout Co., Paw Paw, Mich.*

Bassett, F. R., *Glen Springs Trout Co., Paw Paw, Mich.*

Bigelow, Hayes, *Brattleboro, Vt.* (By H. M. Smith.)

Brown, Thomas W., *Minnesota Fish and Game Association, Glenwood, Minn.* (By S. F. Fullerton.)

Burkhaus, Jerry H., *Torresdale Hatchery, Holmesburg, Philadelphia, Pa.* (By W. E. Meehan.)

Canfield, H. L., *Bureau of Fisheries, Washington, D. C.* (By Frank N. Clark.)

Carter, George L., *Lincoln, Neb.* (By W. J. O'Brien.)

Conway, R. J., *Director Aquarium, Belle Isle, Detroit, Mich.* (By Frank N. Clark.)

Cutter, William, *Mill Creek, Mich.* (By Dwight Lydell.)

Cheyney, John K., *Tarpon Springs, Florida.* (By H. M. Smith.)

Davies, David, *Bureau of Fisheries, Northville, Mich.* (By Frank N. Clark.)

Delaney, O. J., *129 Front St., New York.* (By H. M. Smith.)

Dickinson, G. C., *Fish Culturist, Harrietta, Mich.* (By Seymour Bower.)

Evans, A. Kelly, *Secretary Ontario Fish and Game Protective Association, 25 Front St., East Toronto, Ontario.* (By T. S. Palmer.)

Grill, John H., *Vice President, Minnesota Fish and Game Commission, Sherburne, Minn.* (By Samuel F. Fullerton.)

Hankinson, T. L., *Charleston, Ill.* (By Prof. J. E. Reighard.)
Hartman, Philip, *Erie Hatchery, Erie, Pa.* (By W. W. Meehan.)
Hughes, William H., *Vice President Missouri Fish Commission. 221 Wainwright Bldg., St. Louis, Mo.* (By C. W. Willard.)

Johnson, O. J., *President Minnesota Game and Fish Association, Glenwood, Minn.* (By Samuel F. Fullerton.)

Leisenring, W. A., *Mauch Chunk, Pa.* (By W. E. Meehan.)
Locher, William, *Kalamazoo, Mich.* (By Frank Lydell.)

Marty, John M., *Fish Culturist, Minnesota Fish and Game Commission, St. Paul, Minn.* (By Samuel F. Fullerton.)

Pennington, Robert, *Wilmington, Delaware.* (By H. M. Smith.)
Porter, Richard, *President Missouri Fish Commission, Paris, Mo.* (By C. W. Willard.)

Shortal, J. M., *Secretary Missouri Fish Commission, 906 Chestnut St., St. Louis, Mo.* (By C. W. Willard.)

Thomas, H. G., *Bureau of Fisheries Station, Put-in-Bay, Ohio.* (By J. W. Titcomb.)
Tinker, Eugene, *Corry Hatchery, Corry, Pa.* (By W. E. Meehan.)

Waddell, John, *Grand Rapids.* (By Frank Lydell.)
Whipple, James S., *Forest, Fish and Game Commission, Capitol, Albany.* (By John D. Whish.)
Wolters, Charles A., *Prospect Brewery, 12th and Mervine Sts., Philadelphia, Pa.* (By W. E. Meehan.)

Motion made and seconded that the rules of the society be suspended and that the secretary be authorized to cast the unanimous ballot of the meeting electing the foregoing applicants to membership in the society.

Motion unanimously carried.

The secretary cast the ballot pursuant to the motion.

President: The applicants are unanimously elected to membership in this society.

The following gentlemen were unanimously elected honorary members of the society:

Prof. Dr. Franz Steindachner, *Royal Natural History Museum, Vienna, Austria.*

Prof. Edmond Perrier, *Director National Museum of Natural History, Paris, France.*

*Prof. P. P. C. Hoek, *Scientific Fishery Adviser of the Dutch Government, The Hague, Holland.*

Dr. Oscar von Grimm, *Inspector-General of Fisheries, St. Petersburg, Russia.*

Mr. Franz von Pirko, *President Austrian Fishery Society, Vienna, Austria.*

Mr. Guiseppe Besana, *President Lombardy Fishery Society, Via Torino 51, Milan, Italy.*

Dr. Decio Vinciguerra, *Director Royal Fish Cultural Station and Aquarium, Rome, Italy.*

Mr. Fred J. Adams, *Grand Rapids, Mich.*

President: Before we take a recess for our luncheon I will inquire if there is any specific matter that ought to be brought up at this time. If there is we can consider it.

It devolves upon the presiding officer to appoint standing committees. I have busied myself as well as I could during the morning hour, and in view of the fact that there is always more or less of a contest on two important matters, I have deemed it wise to name two of the committees now and reserve the privilege, if I may, of naming the other committees some time during the afternoon session.

The first committee that the presiding officer is called upon to name is that on nominations. The other is the committee on location. Of course, in regard to the first, I know myself that it is a high honor and that there will be various applicants and I thought, if that committee was named now so that those who have claims to present would have the time to do it, it might be perhaps more convenient. As to the location, we all know that there are a great many places that seek to have us hold our meeting there, and likewise there would probably be some contest,

*On furlough until autumn 1907, as General Secretary to the International Council for the Study of the Sea, Copenhagen, Denmark.

and I have, therefore, thought it wise to name that committee as well.

For the committee on nominations I have thought the society could do no better than to have me name Mr. Henry T. Root as the chairman. The other members of that committee are Mr. Frank N. Clark of Northville; our old friend who is somewhat ill but has been a long while with the society and a valued member of it, whom you all know, Mr. J. J. Hogan of La Crosse, Wis.; Dr. T. H. Bean, whom you all know, who has been with us a long time, and Mr. S. P. Wires.

As committee on location I will name the following gentlemen: Samuel F. Fullerton, Mr. W. E. Meehan, Mr. C. W. Willard, Mr. Herbert D. Dean, and Dr. E. A. Birge.

Mr. Clark: There is one important committee I think necessary at this time which is a programme committee for the present meeting. We have always had one appointed.

President: I think this suggestion is wise and with the permission of the society I will name our worthy secretary, Mr. Peabody, as chairman, Mr. John W. Titcomb and Mr. Dwight Lydell.

I desire to suggest at this time that the Grand Rapids committee on arrangements, as some of you and perhaps all of you know, have arranged for a banquet some time tomorrow evening. It has been suggested to me that seven o'clock would be a convenient hour. One of the reasons why that hour has been suggested is this: they have most graciously put at the disposal of this society an electric car or sufficient electric cars to transport the entire society to the Lakeside Club, where the banquet is to be held, and it was suggested in the same connection that a visit to the state hatchery at Mill Creek be taken also in the afternoon, so that we could take the car about four or five o'clock, or whatever time is agreed upon, and go down to the hatchery, look that over, and then the same car would transport us to the Lakeside Club where we have our banquet.

It will be remembered by those who attended the meeting last year that a resolution was adopted, which, of course, would not be binding upon this meeting but was a suggestion, that the forenoon of the second day of the meeting should be given up entire-

ly to committee meetings and be an open date, so far as the society was concerned; but if you should determine to take the afternoon to go over to the hatchery, perhaps the suggestion that we meet in the morning to transact some business and have some papers read would not be out of the way, and if that meets with your views we will do so.

Mr. Root: I move that when we meet we meet here tomorrow morning at 9:30 o'clock for the transaction of any business that may come before us.

Mr. Titcomb: Was not this committee on programme appointed for the purpose of laying out the whole of this business from now until we get through?

President: Yes. I suppose we had better refer the whole matter to the committee on programme.

Mr. Clark: I move that this matter be referred to the committee on programme.

Motion seconded and unanimously carried.

President: I take the liberty in behalf of the society to thank our friend, the mayor, and Mr. Felger as representing the Sportsmen's Association, for their kind words and for their invitation, and while I shall not avail myself of the suggestion to visit the places suggested by the mayor, undoubtedly a great many members of the society will. (Laughter.)

A recess was here taken until 2:30 p. m., same day and place.

AFTERNOON SESSION.

Same day, Tuesday, July 24, 1906, 2:30 p. m., same place. Meeting called to order by the president.

President: I understand that the programme committee is ready to report, and as we are without any real order of business until we get that report, I will call for the reading of it now.

Mr. George F. Peabody of Appleton: The committee recommends the adoption of the following programme:

Tuesday, July 24, 1906, 2:30 p. m.

Reports of committees and unfinished business.

Election of members always in order.

Reading and discussion of papers in the order suggested by committee on programme.

Adjourn 5:30 p. m.

Evening session at 8 p. m. sharp at Ryerson library.

Illustrated lecture by Professor J. E. Reighard.

The subject of that lecture is Nest Building Fishes of Michigan.

Wednesday, July 25. Meet at 9 a. m.

Reading and discussion of papers.

Adjourn at 1 p. m. until 3 p. m.

At 3 p. m. take special car or cars in front of Hotel Pantlind for Mill Creek Hatchery.

Paper by Dwight Lydell, also by Professor Reighard.

Return from Mill Creek to Lakeside Club without stop.

Guests of the club for the evening.

Thursday, July 26.

Leave Union Depot at 7:30 a. m. for Paris.

Hold a meeting there after examining the station.

Have dinner as guests of Michigan Fish Commission.

Leave Mill Creek at 2:20 p. m. for Grand Rapids.

Meeting will then adjourn.

President: In regard to the trip to the Paris Hatchery I would state that, of course, we would expect all the members and guests of the society to go, and we certainly hope and expect that our friends will come along with us so that we may enjoy the trip and the inspection of the hatchery, and probably get in somewhere during the time a business meeting as well.

We will now receive the report of the secretary.

Secretary: Mr. President, the secretary's report is embodied in the published proceedings for last year, which covers the entire report. These proceedings are in the hands of every member of the society.

President: It seems to me that it is a most complete report in every detail.

Mr. Root: I move that the report be received and adopted. Motion seconded and unanimously carried.

President: We will now receive the reports of standing committees, and first the executive committee.

Mr. Meehan: I shall have to hand in the report in writing a little later to the committee, but I can give it to you verbally. I could not give it in writing before because some of the data had not been handed to me until this morning. I have to report that during the year there were seven deaths in the membership reported to either the treasurer or myself.

W. Osborne of Duluth, Minnesota, who died April 1. 1905.

W. E. Robinson of Mackinaw City, Michigan, who died in 1905.

E. St. George Tucker, who died in Halifax in 1904.

J. C. Willetts, New York City, who died August 31, 1905.

Judge Uri Lamprey, St. Paul, Minnesota, May, 1906.

Robert B. Roosevelt, New York, June, 1906.

Charles L. Miller, Altoona, Pa., Oct. 21, 1905.

Charles Walters, Jr., Philadelphia, Oct. 13, 1905.

Henry C. Demuth, Lancaster, Pa., May 30, 1906.

Mr. Demuth was for many years connected with the fishery interests of Pennsylvania, having been the treasurer of the old fish commission for seven years, and was a co-laborer on the board with the late Henry C. Ford whom we all knew as prominent in the fish cultural work of Pennsylvania between 1880 and 1895.

I also have to report that another and great step has been taken toward securing practically uniform laws for the protection of fish in Lake Erie, Ohio, having passed last winter laws practically the same as Pennsylvania did the year before. A bill was introduced into the New York legislature—I heard informally that it has passed—but apparently it has not, at least Mr. Whish informs me that he does not know positively that it has been passed. Canada, of course, does not need to enact special legislation but will adopt similar regulations as soon as all the states bordering on Lake Erie adopt practically uniform laws.

We have also had some correspondence in connection with the International Fisheries Society, but that matter is largely in the hands of Dr. Smith.

Mr. Titcomb: I move that the report be accepted and adopted; that the list of names of the deceased members be referred to the committee on resolutions for proper action in this connection.

Motion seconded and unanimously carried.

Mr. Titcomb: As a member of the committee on foreign relations I wish to present a matter at this time, because it must be attended to now if at all. You will probably remember Mr. De Puy, a comparatively new member from New York, who attended the last meeting of the society. He is going on a two years' trip, and he will visit many countries—in fact nearly all the countries in the world—before he returns. He is an enthusiastic angler and very much interested in the society. I offer a resolution this afternoon in order that it may reach him when he takes his boat. If it is mailed tomorrow morning by the secretary it will do so.

The resolution is as follows:

Resolved by the American Fisheries Society, here assembled in annual meeting, that Mr. Henry F. De Puy be added to the committee on foreign relations and made a delegate of this society to all foreign countries which he may visit during his contemplated sojourn abroad.

It is further resolved that the secretary be instructed to send a copy of these resolutions to Mr. De Puy with the best wishes of the society for a pleasant trip; and a formal certificate addressed "To whom it may concern," stating that Mr. De Puy is a delegate authorized to confer with fish culturists and to represent this society at any meetings or conferences he may find it convenient to attend during his absence in foreign countries; said certificate to be signed by the president and the secretary of the society.

Motion made, seconded, and unanimously carried adopting the resolution.

Mr. John E. Gunckel of Toledo, O.: Within the past twenty-five years I have been recording secretary several times, and when I was recording secretary you always asked for my report. You still have a recording secretary and I would like to hear his report so as to learn what improvements have been made since the

time when I held office. You know, of course, I live in Toledo and have the reputation of being the biggest fish liar in the United States; but I continually receive letters of inquiry from foreign countries, and some very curious scientific questions are being asked me. The angling part of it I take a great deal of pleasure in answering, but you would be surprised to see the correspondence I have from foreign countries about the American Fisheries Society, although I have not been recording secretary for many years.

Mr. Peabody: As recording secretary I would like to ask why the gentleman does not refer this correspondence to the present recording secretary?

Mr. Gunckel: I generally refer everything of a scientific nature to you, but as to the other matters I perform my duties under my salary and answer the communications myself.

Mr. Peabody: I have a communication from Dr. Smith that perhaps would come under the head of unfinished business. It is as follows:

You will recall that I corresponded with the officers and the executive committee relative to an award to be offered by the Society at the next International Fishery Congress. All responded favorably, and the majority of those who suggested any subject for the award mentioned fish diseases. Accordingly, I made the following announcement in the circular which has been sent to the members:

"By the American Fisheries Society: For a paper embodying the most important original observations and investigations regarding the cause, treatment and prevention of a disease affecting a species of fish under cultivation, $100 in gold."

Will you please bring this matter to the notice of the Society, and have the foregoing action ratified?

Dr. Birge: I move that the action of Dr. Smith be ratified and accepted as the action of the society.

Motion seconded and unanimously carried.

Prof. Jacob Reighard then presented a paper on "The Identification for Legal Purposes of Mutilated or Dressed Specimens of Whitefish and Herring from the Great Lakes."

Prof. Reighard: This paper and the one that follows on the programme are announced as illustrated by lantern slides. When the local committee made its arrangements, they thought, from the fact that lantern slides were mentioned in the programme that this paper might be suitable for the general public and therefore placed it in the evening. On learning of this action I undertook to give an evening lecture that would possibly interest the general public more than this paper, and I have therefore cut out the lantern slides from this paper, but I have here three or four photographs which will serve to illustrate it.

Mr. Samuel F. Fullerton of St. Paul, Minnesota, read a paper on "Protection as an Aid to Propagation."

Mr. George F. Peabody then read a paper by Mr. Albert Rosenberg of Kalamazoo, Michigan: "Some Experiments in the Propagation of Rainbow Trout."

Mr. Titcomb then read a paper by Dr. Hugh M. Smith, on "Fishery Legislation before the Fifty-ninth Congress," (first session).

Mr. Titcomb: I think it would be a good idea if the society could have at each meeting the bound volumes of the proceedings of the society for all the years. My suggestion is that the secretary be authorized to have a set of the transactions of the society bound and put in a proper box which can be taken from one meeting to another, and during the sessions be accessible to all the members, and I make a motion to that effect.

Motion seconded and unanimously carried.

Mr. Titcomb: I move that the auditing committee be also made a committee to co-operate with the secretary and treasurer, in order to weed out delinquent and deceased members from the present list and revise the list for the next publication. Some of the addresses now given are wrong. Some have passed away, and Mr. Willard can undoubtedly report on some who have not paid for years. Is not that so?

Mr. Willard: I can.

Motion seconded and unanimously carried.

President: I will appoint as the auditing committee:

Mr. George M. Brown, of Michigan; Mr. A. D. Roberts, of Rhode Island; Mr. R. S. Johnson, of Iowa.

As members of the committee on resolutions I will appoint: Mr. John D. Whish, of New York; Mr. W. E. Meehan, of Pennsylvania; Mr. John W. Titcomb, of Washington, D. C.

Mr. Meehan read a statement of the fish distributed by Pennsylvania from January 1, 1906 to July 1, 1906.

Adjourned to 8 o'clock p. m., same day, at the Ryerson Public Library.

EVENING SESSION.

Public Library, same day, 8 p. m. Prof. Jacob Reighard delivered a lecture on the subject of the Domestic Life of Fishes that Build Nests and Take Care of Their Eggs.

Adjourned to next day, Wednesday, July 25, 1906.

Wednesday, July 25, 1906.

Board of Trade Building, Grand Rapids, Michigan, July 25, 1906, 10 a. m. Meeting called to order by the President.

Mr. Titcomb: There is an organization in this country called the American Breeders' Association, formed two years ago by the Assistant Secretary of Agriculture. This association has taken up the work of improving breeds of animals and plants. You have undoubtedly all read about Burbank's work out in California, the wonderful things he has accomplished in plant life of all kinds.

Now the American Breeders' Association has the work divided up by committees, each committee having a special line. I was made chairman of the committee on fish breeding and was requested to ask the co-operation of all members of this society in certain lines. For instance, we would like to know from every one who has done any work on hybridization of fishes, details as to what they have done, and how far the work has been carried. We would like to have every one who has done any fish cultural work, or who has had any opportunity to do fish cultural work, continue still farther these attempts to cross different species.

Now it is very surprising to think that you can take the eggs of a 50-pound rock bass and fertilize them with the milt of the herring, or the opposite, though, of course, with that class of fish it is almost impossible to carry your experiments to a conclusion, because the fish are liberated as fry and go to the ocean. But we want to take up this subject of hybridization on a larger scale, cross the inferior species perhaps with some finer ones, and rear the fish to see if we can get any results by continual attempts at crossing.

Then this committee wants to take up some other subjects. This will apply more to the commercial hatcheries such as improvement by selection. We would like reports on what has been done by commercial breeders, breeding for increase on egg production, breeding for resistance or immunity to disease. There is a large field in those directions, and the data on what has been done in the past are very limited.

The committee appointed by this association consists, besides the chairman, of Mr. Seymour Bower, of Detroit; Mr. C. A. Vogelsang, of San Francisco; Mr. Charles G. Atkins, of East Orland, Me.; Mr. C. C. Wood, of Plymouth, Mass.; Mr. H. M. Smith, of Washington, D. C.; Mr. W. J. Moenkhaus, of Bloomington, Ind.; Mr. A. D. Mead, of Providence, Rhode Island; Mr. H. J. Wolf, of Philadelphia, Pennsylvania; and Dr. George W. Field, of Boston, Massachusetts.

Mr. Meehan: Do I understand you to say that there was successful fertilization between the rock-fish or striped bass and the herring?

Mr. Titcomb: Yes sir.

Mr. Clark: By what association was this committee appointed?

Mr. Titcomb: Appointed by the American Breeders' Association which really originated in the Department of Agriculture. The association advised this committee, and I think this society ought to co-operate with it in every way they can.

Prof. Reighard: That is a committee of the Breeders' Association and not of this society.

Mr. Titcomb: That is true.

Mr. President: Any suggestion or resolution in connection with this?

Mr. Titcomb: No. I thought it would get on the record in the report in this way, so that the members would contribute when anything occurs to them.

President: It occurs to the president that this is a very wide subject. The representatives from the different states who are in charge of fish culture in those states, would do well to take heed to these suggestions by Mr. Titcomb, with a view to ascertaining what results can be produced. In a year or two we will be getting reports I believe that will be of value to all the states.

We will now listen to the report of the committee on nominations.

Mr. Root: When you appointed me on this committee you gave me what you believed to be a pretty difficult task. You were never more mistaken in your life. I never sat on a committee where there was more unanimity. There was not a suggestion contrary to what I shall report. Of course in a society of this size there are a great many men who are worthy of being president and capable of it and whom we would like to see in that office but we cannot all get there the same year.

The first nomination made was of a gentleman for president who not only has an international reputation—and these are international days, you know—we have to have a little "international" in everything—but he also has a great local reputation as a scientist and practical fish culturist; and I am glad to say that he is one of your western men. Without further remarks I will put in nomination the list decided on in a very few minutes with perfect unanimity.

For President, Dr. E. A. Birge, of Madison, Wis.

For Vice President, Dr. H. M. Smith, of Washington, D. C.

And let me say right here that Dr. Smith would naturally have been nominated for president this year, but we all know of the great international congress that is coming, and it was the feeling of the committee that he should be nominated for

our president next year. Of course that will be for the next year's meeting of the society to say.

For Recording Secretary, George F. Peabody, of Appleton, Wisconsin.

For Corresponding Secretary, Charles G. Atkins, of East Orland, Me.

We had a good deal more discussion about the treasurer than anything else. (Laughter.)

C. W. Willard, of Westerly, Rhode Island.

Executive Committee:

John D. Whish, Chairman, Albany, New York.

Mr. E. Hart Geer, Hadlyme, Conn.

J. S. Henshall, Bozeman, Mont.

S. F. Fullerton, St. Paul, Minn.

Prof. Reighard: I move that the rules be suspended and that the secretary be instructed to cast the unanimous ballot of the society for the entire list of nominees as read by the chairman.

Seconded, unanimously carried and so done.

Dr. Birge was called for. (Great applause.)

Dr. Birge: I feel it is a great honor to be elected president of this society. I shall endeavor to perform the duties of the office to the best of my ability, and I trust the meeting over which I hope to preside a year from now will be a successful one.

(Mr. Titcomb called for.)

Mr. Titcomb: I am sure if I say anything for Dr. Smith I shall be talking for a man that won't blow for himself; he is one of the most modest men I ever knew, a thorough gentleman, who is well posted on the work of the Bureau of Fisheries, the results of many years' experience. His heart is in this work and in the later years I have been pleased to see him take such an active interest in this society. I think he has secured more members in the last two years than any other member here. I am sure we have not made a mistake in honoring him with the position of vice president and I hope on the occasion of the International Fisheries Congress that he will be the president of this society.

President: I know you will all be glad to hear from the newly elected chairman of the executive committee.

Mr. Whish: Mr. President and gentlemen, after reading our constitution carefully and consulting with the members of the committee, I will know more about what this committee is expected to do than at the present time. Of course our progress will be largely guided by the very efficient executive committee preceding this committee. A considerable experience in organized bodies has led me to believe that the executive committee is not a place for play. It ought to be a place for work, and in a body like this, for a lot of good work. The able men with whom I shall be associated will undoubtedly make up for deficiencies on my part; and I sincerely hope the work this new committee does will be as satisfactory to the society as has been the work of similar committees in the past. Any suggestions which any member may have in mind will be gladly received by this committee, I know. I shall be glad at any time to hear any suggestions from any member of the society, and inasmuch as my name is easily written and my address is readily remembered, there will be no difficulty in reaching me, there being fortunately only one family of my name in the United States that I know, and certainly only one man of that name located in the capitol at Albany.

Thank you for the very high honor I have received. (Great applause.)

(Secretary Peabody was called for.)

Mr. Peabody: Gentlemen, I feel very grateful for the honor of being continued as secretary, but my gratitude is somewhat tempered by the knowledge that the only reason I am made secretary is because nobody else will take the office, (great laughter) and I must admit that there are some defects perhaps in my administration. It is very difficult to keep a correct record of the addresses. There is a very large number of men belonging to the society whose dwelling place changes, and I would ask every one to be particular and send me any change of address, that it may be properly recorded, so that all the members may get the documents, pamphlets and whatever is sent out by the society.

President: The general promoter of the financial welfare of the society is called for—Mr. Willard.

Mr. Willard: I did not hear any one call for me.

President: I can speak louder. (Laughter.)

Mr. Willard: I deem it an honor to serve this society in any capacity and I thank you very much for this further evidence of your confidence and esteem, and I will try to serve you as faithfully in the future as I have in the past. If there is a shortage I will make it up. (Great applause.) If there is a superabundance of funds I will divide with you. (Laughter.)

President: That is very fair indeed.

I am glad to see the society return to a course which I believe is the wisest it can pursue, in selecting for its president such a man as Dr. Birge. I have honestly felt that while I am identified somewhat with the fish cultural work of Michigan, I am not a well-known scientist, and indeed not a scientist at all, and it has seemed to me during the entire time that I have held this office that the interests of the society would have been much better promoted had it then selected some well known scientist of international reputation as its president; and it is well for the society to return to the policy of selecting such men as Dr. Birge, and other men whom I hope in the future will follow, as chief executive officers of this society. I am glad to say to Dr. Birge that the society in honoring him, in my opinion, has still more honored itself. As my predecessor said to me, I am obliged to say to you, that I cannot at this moment yield up the gavel to you, but at the close of the meeting here I shall turn it over to you with the utmost pleasure.

(Great applause.)

Dr. Birge: May I say just a word in reply to your kind words? I feel deeply the honor to science as well as the personal honor involved in my election as president. Yet I should feel it a very great misfortune to this society if that policy which you indicate should be adopted and pursued regularly. The great charm of this society, to all of us who are members, lies in the fact that it brings together not merely the scientists but all

those who are interested in fish culture, from every point of view. The standing of the society in the United States depends on the strong union of all interests for fish culture, and on having all of those interests represented in the society and in its officers. I am very glad, Mr. President, that you were elected President last year. It would be a misfortune if men who are interested in the practical culture of fish as you are, should feel themselves in any way barred from the control of the affairs of the society. Such a misfortune is impossible since a most important part of the control of the affairs of such a society as this comes from men who are interested from the point of view which you and your fellows in the society hold.

I need not say that the remarks of the President in regard to his own administration were altogether too modest because we all of us appreciate the success which the society has had during the past year and to which he has contributed so much.

Mr. Clark: If I am not trespassing upon the time of this society I would like to say, as a member of long standing in the organization, also as a practical fish culturist and not a scientist, I would like to say to Dr. Birge and the members, that the practical side of fish culture from now on must have more of the help of the scientist. In other words the successful practical fish culturist of today has to be a scientist so far as possible. We have come to that day and age when our farming, breeding and nearly all other pursuits are followed on well based scientific principles, and we must have more of the help of the scientist in fish cultural work. Therefore, I say, let the scientist element have better recognization than has been shown in the past.

President: I am compelled to tell a short story in regard to the outcome of this election. Away back in the 80's the State of Michigan had a very furious canvass on for the nomination for the position of governor, in the republican party. I think there were six candidates and all had about the same number of followers in the convention. The late Roswell G. Horr presided at that convention, and what he said to that convention before it opened its labors I would like to have regarded as said to this society with regard to the outcome here. He said, "Gentlemen, you are all here, each one earnestly active in support of his own

candidate, and thinking that the world swings around and will be governed by the success of his own candidate; but when it is all over and the final ballot is cast, every one of you will see then that the hand of Providence was in it from the start." (Laughter and applause.)

Is there any miscellaneous business to be taken up at this time?

Secretary: I should like to read the following communication:

Silver Lake, Mass., July 18th, 1906.

Mr. Geo. F. Peabody, Secretary, Grand Rapids, Mich.

Dear Sir: It is with sorrow that I write you that my father, Mr. George F. Lane, passed away yesterday.

He has been failing the last two years and died of a weakened heart.

He was taken away when the prospects of the trout business seemed the best, as he had more stock on hand at the time of his death than ever before. Yours truly,

HARRY L. LANE.

(This communication was referred to the committee on resolutions.)

Mr. Titcomb then read a paper on Progress and Experiments in Fish Culture in the Bureau of Fisheries During the Fiscal Year 1906.

Mr. Seymour Bower: I would like to have the chair take a rising vote as to the number of members who will go to Paris tomorrow.

President: It is rather necessary in order to make arrangements with the railroads that we know exactly who will go to Paris tomorrow, and in order to ascertain that, before Mr. Atkins starts with his paper, I will ask you to rise, stand and be counted.

Mr. Dean: There are some strangers here and we would like to know about the fare, etc.

Mr. Bower: If fifty go the fare will be $1.85 for the round

trip. If we cannot get fifty they will probably make a little higher rate, but will give special rates. If there are any strangers here who have not been to Paris, they will miss the opportunity of their lives if they do not go. The wild trout for a good dinner are all caught and ready to be dressed.

President: As I understand, everything has been caught but the men.

Mr. Dean: What time can we return to Grand Rapids?

Mr. Bower: We leave Grand Rapids at 7:30 in the morning and return here at 4:45 p. m.

A vote was taken and thirty-three said they would go.

Mr. Charles G. Atkins of East Orland, Me., read a paper on the subject of Experiments in the Fasting of Fry.

Dr. E. A. Birge then read a paper on the subject of Gases Dissolved in the Waters of Wisconsin Lakes.

Mr. Brown: In the absence of the President a couple of weeks ago, and in the line of our interests in beautifying our grounds as an object lesson at one place, and at another to beautify them and to protect the springs and streams that furnish the water of our hatcheries, I wrote to Prof. Filibert Roth of the Michigan University, asking him if he would make a few remarks on the line of forestry, which I thought would be easily adapted to our and many United States Stations very much to their advantage. He is present with us and we would like to have him give us the benefit of his experience.

Prof. Roth then addressed the society on the subject of The Fisherman and Reforestation.

Mr. Meehan then explained a new type of jars for hatching, designed by himself.

President: There are on the table here some circulars with reference to the International Fisheries Congress to be held in 1908 at Washington, showing the awards of premiums offered for different papers. They lie on the table and we will be glad to have the members take them as they pass out.

An adjournment was then taken to 3 o'clock p. m., same day, at Mill Creek.

AFTERNOON SESSION.

Mill Creek Hatchery, 4:30 p. m., same day. Convention called to order by the president.

Mr. Seymour Bower read a paper by Mr. Dwight Lydell of Mill Creek, on the subject of The Bass at Mill Creek Station.

Secretary Peabody: I have received a letter from Mr. Henry W. Beeman, of New Preston, Connecticut, who has been raising small-mouth black bass for about four years and has had remarkable success in their propagation. I requested a paper from him on the subject, but he has been too busy to prepare one, and he simply wrote a letter that has a few points in it that might be noteworthy to those interested in black bass.

The secretary then read the letter referred to.

Mr. Clark then read a paper by Mr. J. J. Stranahan of Cold Springs Station, Bureau of Fisheries, on Assorting Brood Black Bass to Prevent Cannibalism.

Mr. Lydell explained the advantages of Sherwin & Williams Pure Atchison Graphite Paint, for painting screens.

Mr. John L. Price, of Drayton Plains, Michigan, explained the advantages of a device invented by him, consisting of a tube for aerating water.

Meeting adjourned to convene at Lakeside Club, Grand Rapids, Michigan, at 8 p. m., same day.

EVENING SESSION.

At 8 p. m. a banquet under the auspices of the Consolidated Sportsman's Club was given at the Lakeside Club, Reed's Lake. Mr. Fred J. Adams acted as toastmaster. He said that he thought Michigan had one of the best fish commissions in the country, and that it was entirely out of politics; that the appropriation of the commission was small, but that they made every dollar count.

"Our lakes and streams are in excellent condition and they

would be in still better condition if they were properly protected, and the method of protection is a problem that still confronts us."

President Joslyn: I am very glad to hear these remarks of Mr. Adams commendatory on the work of the fish commission. I am proud to say that we really never have had any politics in the commission.

We have believed that the work in which the commission is engaged is a serious one; we have believed furthermore that it was a work which would interest the people of the state. We are engaged in the same work that you gentlemen of the society are engaged in—work not for ourselves, not for our immediate friends or relatives, but almost exclusively a work for those who are to come after us. Because of the character of our work we believe we can see what the future is to bring forth in regard to the food fishes of this country, unless some work like that in which we are engaged is done; and so I take pleasure in saying that, so far as the Michigan Fish Commission is concerned, and I know that so far as our society is concerned, we have let politics severely alone and given our whole time and attention to the work which we had in hand, and that is the reason, Mr. Toastmaster, why we could give so little time to the generous propostions for entertainment which you made when you found out that we were coming to Grand Rapids. But I will say to you, and I believe the members of this society will agree with me, that the papers which have been read at the meetings thus far held in Grand Rapids, and the discussions which followed the reading of those papers, have been of the very best, and will, beyond all question, be productive of good results, not only of advantage to us in Michigan, but to every fish and game commission throughout the United States which has had representatives here to hear and take part in these discussions.

I take occasion here now, because it probably will not again be afforded me, as our time will be fully taken up with other matters tomorrow, to say to you one and all that I most thoroughly and gratefully appreciate the honor which you gave to me a year ago, of presiding over your deliberations. It is an honor which I shall always remember and I realize that even if our

constitution did not prohibit, the years which have rolled over my head are so many that in the ordinary course of a lifetime, it is an honor which can never come to me again, and I want to return my thanks to this society for the courteous manner with which they have carried on their deliberations, and the respect they have paid each other and the dignity of the society, and I thank you gentlemen, one and all. (Great applause.)

The toastmaster then called upon the president-elect, Dr. E. A. Birge. (Great applause.)

Dr. Birge: There is only one thing I want to say and that perhaps I may say as coming from the next door neighbor of the state of Michigan. The state of Wisconsin has looked to Michigan for many good things. I know that perhaps better than any of you here, because we who have belonged to state universities anywhere in the country, look toward the University of Michigan as the mother of the state universities of the country. We have looked to Michigan for a great many years for help in state university affairs and have never failed to find it, we have looked to the University of Michigan as representing in a very high sense the State of Michigan, and we have been proud to recognize the state and the university together. As a member of the Fish Commission of a sister state, I may say that there too we have had great assistance from Michigan in carrying on our work. We, too, have had no politics in our commission; our employees have been with us, many of them, all their lives. Ten, fifteen and even twenty years they have served us, and we expect them to serve us as long as they live. They have been efficient men and we do not know or care what their politics are. Politicians have always let us alone; we have not had politics thrust upon us, and we have not in any way courted politics ourselves. We have attended to the propagation of fish, and in working in that way have found ourselves in full sympathy with the efforts of the commissioners on this side of Lake Michigan. We have felt that their policy strengthened ours, and sometimes hoped that our policy on our side of the lake has been of advantage to them when they needed it. And the policy of the fish commissioners, as I have known them in general, seems to have been that of this Fisheries Society, organized for work rather than

for play, organized for business rather than for junketing trips. And so while we have met here, Mr. Toastmaster, and have enjoyed your kind hospitality, and are grateful for all your kindness, we, in some sense, are glad that we could not enjoy it any more, because we feel that we have accomplished in some measure the work which our states have sent us here to do.

Adjourned to meet at Paris, Michigan, next day, Thursday, July 26, 1906, at 11 a. m.

Thursday, July 26, 1906.

Paris, Michigan, July 26, 1906, 11 a. m.

Meeting called to order at the grounds of the State Fish Commission, by the president.

President: If you will come to order we will transact a little business. There is yet some unfinished business and some few reports that have not been made, and I think we will transact the business first. I understand that there are those who desire to ask some questions about this hatchery. If there is time we will take that up after the transaction of business.

The report of the Auditing Committee is now in order.

Mr. Brown: We checked the bills and accounts and certified on the report of the treasurer its correctness.

Report unanimously adopted.

President: We will now hear the report of the Committee on Foreign Relations, Mr. Atkins.

Mr. Atkins: Mr. President and gentlemen, the committee on foreign relations has prepared a report of which I think the volume will be a little too much to read to you now, and I will therefore beg to read the introductory pages and some of the details, and will then file the report.

Mr. Atkins then read the report.

On motion of Mr. Meehan the report was received and accepted.

Report of the Committee on Resolutions by Mr. Whish, chairman.

Mr. Meehan has prepared resolutions of regret on those who have passed away. I suggest that inasmuch as the late Robert Roosevelt was president of the society, more detailed obituary notice be prepared of his death, for next year.

I would like to offer a resolution in this connection relative to the very handsome treatment we have received at the hands of the Sportsmen's Club at Grand Rapids.

Resolved, that the consideration shown to the American Fisheries Society by the people of Grand Rapids, and especially by the Board of Trade, whose commodious meeting room was placed at our disposal, merits hearty thanks, and that the secretary convey the hearty appreciation of the society for courtesies received.

Resolved, that thanks be tendered to the Sportsmen's Club for the handsome entertainment given this society. We found them to be true gentlemen and we congratulate them on their work for the preservation of the fish and game of Michigan.

It has seemed to me that in view of the very remarkable practical work which we have seen of the commission in this state, that something should be said expressing the appreciation of the society, as shown individually and collectively in its discussion of this work.

Resolved, that the visits paid by the American Fisheries Society to the several hatcheries of the Michigan State Fish Commission, disclose how advanced and extensive is their work, and the society congratulate the commission on its position in the front rank of fish culture.

Resolved, that the heartiest thanks of this society are extended to President Joslyn and his associates for their earnest and successful efforts in advancing the interests of this society.

ROBERT BARNWELL ROOSEVELT.

Born, August 7, 1829.
Died, June 14, 1906.

A kindly man who loved the gentle art of angling, and whose interest in his favorite sport led to the first practical work in fish culture in the United States, was Robert B. Roosevelt, once President of the American Fisheries Society. By birth he was a New York City man; by education, a lawyer; by every instinct, a true sportsman. Sometime in the early sixties, generally agreed to be in 1865, while at the annual gathering of the State Sportsmen's Association, he met the famous Seth Green, and a mutual interest in fly casting made them fast and life-long friends. A few years after this meeting Mr. Roosevelt inherited ample means and gave up the practice of the law which he began in 1850, to devote his time to the congenial work of assisting his friend to make trout culture at least a possibility, and to secure adequate laws for game protection. With his aid Green started a little hatchery at Caledonia, in New York state, and here worked out the problem of brook trout culture. The place is now the site of the greatest fish hatchery which the Empire State owns, and is known the world over.

In 1867 Mr. Roosevelt drafted the bill under which the Fisheries Commission of New York state was created and became one of its members. Mr. Green was its superintendent. In 1872, while Mr. Roosevelt was a member of Congress, the bill was passed creating the National Fish Commission, whose work is the greatest in the world. In 1888 he was appointed Minister to the Netherlands and served with honor. Politically, socially and as a sportsman he worked for the general betterment of things as he found them. He was frequently honored by his fellow citizens and was continually an honor to them. As a president of the American Fisheries Society he added much to its efficiency as an organization, and the Society has ordered this page set apart to his memory in its published transactions.

Report unanimously adopted.

President: The chair desires to state that he prepared a notice with reference to Dr. Parker as he was requested to do a year ago. He submitted it however to some of the friends, who desired to make a little revision, and for that reason the obituary notice was not received in time to print in the present proceedings. In view of the great work which Dr. Parker did I still think that a notice of him and his work should appear somewhere in these proceedings and would ask permission to have it sent to the secretary of the society so as to appear in the next year's transactions, if that is agreeable to the society, and unless I hear objection I will take it for granted that it may be done.

President: We will next hear the report of the Committee on Location.

The report was presented by the chairman recommending that Erie, Pennsylvania, be the next place of meeting.

Motion made, seconded and unanimously carried adopting the report.

Mr. Meehan: On behalf of the City of Erie, Pennsylvania, I wish to say that I think the members have chosen wisely, and I am quite satisfied from what I know of the City of Erie, and the people who live there, that the society will have made no mistake in going there. There are many things that will be of distinct advantage to the society. The city is not what you call a large city, having only 62,000 inhabitants, but it has several good hotels, and one in particular which is first class and will house the entire society. The Board of Trade and Chamber of Commerce and one or two of the other prominent concerns in the city will look after our comfort and pleasure and so will the Department of Fisheries of Pennsylvania. There are very large fisheries on the lake and boats will take us to the fishing grounds, and observe the methods of work in Lake Erie and our fisheries rank second on that great lake. There are at least two hatcheries, aside from the one in the City of Erie, which will be of interest probably to the members, one being for trout and the other for bass and lake fishes, and in the City of Erie, there is a little hatchery not supposed to be in operation in July,

being a battery station. You will find two things of interest, one a little frog pond, another an illustration of our work in retaining whitefish in quantities for planting in the lake, after bringing them to fingerling size, to three and four inches. Those who may want to extend their trip a little further, can with readiness, visit some of the other hatcheries in the state; and at that time there will be members of the board and myself who will see that they are attended to any or all of the hatcheries they may wish to visit. There will be many other things of advantage also which I will not enumerate, but keep as pleasant surprises. (Great applause.)

Mr. Fullerton: I desire to offer a resolution regarding the protection of the fish in our Great Lakes.

President: I am under the impression that we adopted something of that kind last year.

Mr. Fullerton: I believe in keeping at it.

President: If the society desires again to go on record as still being firm in the belief, I see no reason why it should not be done.

Mr. Meehan: I introduced a similar resolution myself at the last meeting, as chairman of the committee on resolutions.

President: We adopted a broad resolution last year.

Mr. Fullerton: I believe federal control is our only salvation. We should keep at it eternally. If we had as good protection as we have propagation, there would not be any question about our fish.

Upon motion made, seconded and unanimously carried, the resolution was referred to the committee on resolutions.

Mr. Clark: In view of the excellent reports, so far as we have heard, of the committee on foreign relations and believing that a similar feeling as to its excellence exists on the part of every member, I would move that the same committee on foreign relations be appointed for another year.

Motion seconded and unanimously carried.

President: The committee is continued for another year with the same salary. (Laughter.)

Mr. Fullerton: I move that a vote of thanks of this association be tendered to our retiring president, Mr. Joslyn, for his eminent ability and fairness and for the courtesy extended to each member, during his term of office.

Motion seconded, put by the secretary and unanimously carried.

Mr. Joslyn: I thank you most sincerely for your kind words. I am like the man who had written on his tombstone out west, "He done his damndest—angels could do no more." (Laughter.)

Mr. Seymour Bower: At nearly all annual meetings we have elected one or more honorary members and there is a man in Grand Rapids whose name Mr. Lydell would like to present for that honor.

Mr. Lydell: I offer the name of Mr. Fred J. Adams of Grand Rapids, whose paper is always open to anything we ask for, and who has always been ready to do anything he can for the interest of the fisheries of the United States. He could not be with us today and regrets it.

Motion made, seconded and unanimously carried that the rules be suspended and that the secretary be instructed to cast the unanimous ballot of the society electing Mr. Adams as honorary member.

So done.

President: It was suggested that somebody desired to ask some questions about this hatchery or the mode of conducting it, and if so those questions would be in order now.

(Questions were asked and the subject discussed.)

The committee on resolutions presented the following further report: This resolution was offered by Mr. Fullerton.

Whereas, the members of the American Fisheries Society now assembled at Grand Rapids, Michigan, view with alarm the threatened depletion of whitefish, lake trout and other fishes in the waters and boundary rivers of the Great Lakes;

And whereas, Ontario, to the north of us, advocates, "stopping fishing for five years"; and we do not believe such action will produce the desired results, but on the contrary we believe that lack of uniform laws between Canada and the several states bordering on the Great Lakes, and the lack of concurrent jurisdiction for boundary streams, without enforcement of existing laws, poor protection given during spawning season, and a total disregard of the size of fish caught by fishermen, are at the root of the evil; therefore:

Resolved, That it is the sense of this meeting that Canada and the United States ought to enter into a treaty looking to the control of the fish in our Great Lakes, not only the stocking but the protection.

Resolved further: That there should be federal control of boundary streams, and that the states concerned should cede their rights to the national government.

Resolved further: That we heartily commend the efforts that have been made by the Hon. George Shiras, of the third congressional district of Pennsylvania, looking to federal control, and that we heartily pledge him our undivided support.

Resolved further: That a copy of this resolution be furnished to each of our senators and representatives at Washington, also to each member of the Dominion's House of Parliament.

Motion made, seconded and unanimously carried adopting the resolution.

Secretary Peabody: I have some questions for the question box sent by Mr. John L. Leary, superintendent of the San Marcos, Texas, station, and I will read them and the society can decide whether they wish to answer them, or appoint some one to answer them. It might be well to have these questions published perhaps, with the proper replies.

The secretary then read the questions.

Adjourned sine die.

PART II.

SCIENTIFIC PROCEEDINGS.

ON THE IDENTIFICATION FOR LEGAL PURPOSES OF MUTILATED OR DRESSED SPECIMENS OF WHITEFISH AND HERRING FROM THE GREAT LAKES.*

BY PROF. JACOB REIGHARD OF ANN ARBOR, MICHIGAN.

The statutes of Michigan provide (Act 151, P. A. 1897 Sec. 2.) *"that it shall be unlawful to market or have in possession any whitefish weighing less than two pounds."*

Acting apparently under this statute, the deputy game and fish wardens of Michigan, as I learn from a letter written me by the Michigan State Game and Fish Warden under date of February 8, 1906, have frequently seized fish which they believed to be immature whitefish. On February 8, 1906, the Michigan State Game and Fish Warden sent me samples taken from 18 kegs containing 7,800 pounds of fish seized by his deputies as *"immature whitefish."* Concerning the samples he wrote:

"The fish taken from the kegs, the men from whom they were seized claim are menominee, while all the old fishermen whom we have had examine the same, all the deputies who are to a greater or less extent in the commercial fishing business and are educated in the difference between the commercial fishes known under the Michigan law, pronounce them to be a regular whitefish. What we desire at the present time is expert testimony relative to the fish seized from the fishermen, and have it in such form that it could be readily used as evidence in case a suit was appealed to a higher court, showing the difference between a menominee whitefish and a regular whitefish. A fisherman who had followed the business all his life, or one of our deputies might be well versed and well satisfied in his own mind that he could readily tell the difference between a whitefish and a menominee after the head was removd; however, if a lawyer should ask either of these men to define the difference he would be unable to do so by pointing to any feature or con-

*Contributions from Zoological Laboratory of the University of Michigan, No. 106.

dition of either fish which would differ from the other after the head was removed. I presume you will understand what we desire and if we can get the information in such shape that we can instruct the deputies of this department, it will be a great assistance in enforcing the commercial fishing laws. It is quite an important question in the department at this time and I will be under great obligation to you if you can obtain this information in such form that a person not possessing a mind educated in science may comprehend the difference."

With reference to this letter it may be noted that the term *whitefish* as used in the statute is interpreted by both the game and fish wardens and by the fishermen to mean the true whitefish (Coregonus clupeiformis), though I am not aware that the statute has ever been interpreted by the courts. In order then to secure conviction under the statute, it is necessary to show that the fish in question are true whitefish. If they are not *true whitefish,* it does not matter what they are. It is not necessary to show that they are either menominee, black fins, long jaws or herring. It is not necessary that the game and fish wardens should know how to distinguish between menominees, black fins, long jaws and herring. They need to know merely whitefish from that which is not whitefish.

As the question raised by the State Game and Fish Warden is that of distinguishing between whitefish (Coregonus clupeiformis) and menominee (c. quadrilateralis) it may be assumed provisionally that the question of the separation of the true whitefish from the various other species of whitefish and herring present in the Great Lakes does not arise or presents no difficulties.

I received from the State Game and Fish Warden thirty-five fish which had been cleaned by removal of the head and viscera and then split and salted. These were the fish in dispute. Accompanying them were specimens in the round of whitefish and menominees (Coregonus quadrilateralis). Most of these fish sent in the round reached me in such condition that I could not use them, but by utilizing the collection of the University of Michigan and the markets of Detroit, I had for examination in the round: six menominees from Lake Huron; twenty-two white-

fish, one from Lake Huron, twenty from Lake Erie and one of unknown origin; all of legal weight, i.e. two pounds or over.

It was desired to find some means of separating the whitefish and menominees without using the characters founded on the head or viscera. The characters given by Jordan and Evermann (Fishes of North and Middle America, p. 465) for separating these fishes are based wholly or in part on the head, with the exception of (1) the color, (2) the number of rays in the dorsal and anal fins, and (3) the number of scales in the lateral line and of scale rows above and below it.

The color is so nearly the same in the two species as not to afford a reliable means of separating them. The same remark applies to the fin rays, in which the individual variations of one species overlap those of the other. The number of scales in the lateral line and the number of scale rows was found in the specimens examined to be insufficient in itself to separate the two species, the numbers sometimes coming together or overlapping.

It seemed essential in order to distinguish the whitefish and menominee to make use of some character not hitherto used for this purpose. The structure of the scales as they appear under a magnifying glass was finally made use of. Five to ten scales were removed from each of the fish. In each case the scales were taken from the same place, midway between the first dorsal fin and the lateral line on the left side. In order to clean them they were placed for ten or fifteen minutes in a one per cent. solution of caustic potash and were then rinsed and brushed to remove any shreds of soft tissue that might adhere to them. Thus prepared, the scales of each fish were placed between two slides of clear glass and these were fastened together by pieces of gummed paper.

If any one of the scales thus prepared be examined with a good pocket magnifier giving a magnification of ten to twenty diameters the following points may be readily made out. The outline of the scale is somewhat that of a bent bow with its string. The outline is not straight at any point, but one part of it corresponding to the string of the bow is more nearly straight than any other part. At its middle this part projects into a more or less rounded angle as does the bow string when

pulled back by the hand. At its end it joins the rest of the margin by rather sharp angles which correspond to the points where the bow string is attached to the bow. The portion of the

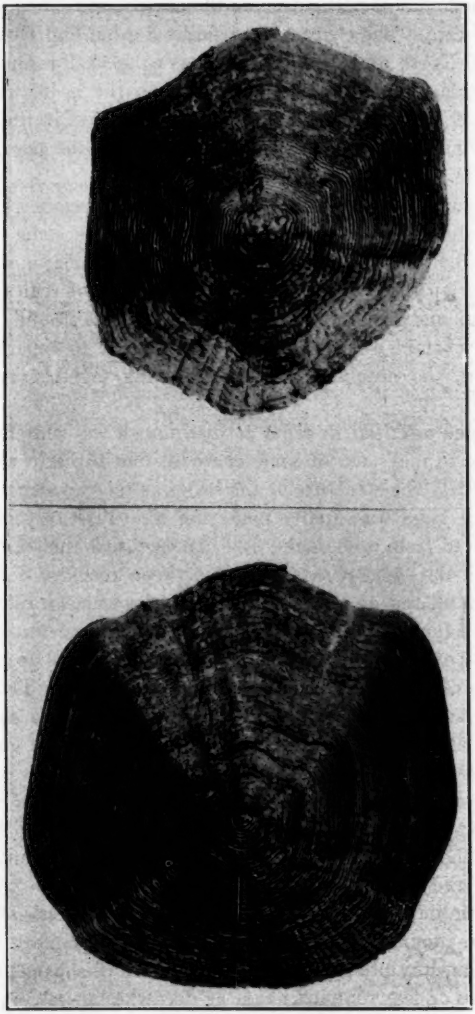


FIG. 1—Scales of Whitefish (Coregonus clupeiformis Mitchill) and Menominee whitefish (Coregonus quadrilateralis Richardson), both from Lake Huron. That of the whitefish is at the left. The scales are viewed as transparent objects and are magnified about ten diameters. From a photograph by the writer.

margin of the scale that corresponds to the bow-string is directed towards the head in the natural position of the scale and we may call it the cranial border of the scale. The rest of the margin, corresponding to the bow, forms a continuous and more or less smooth curve, but may be divided into three parts. One of these looks towards the tail in the natural position of the scale and is the caudal border. One is directed towards the back of the fish, the dorsal border, and the other toward the belly, the ventral border.

Somewhere near the center of the scale is a small, smooth area, which represents the center of the original scale of the young fish to which additions have been made from time to time by the growth of the scale. This smooth area may be called the growth center of the scale. Between the growth center and the border are numerous fine striations which form concentric lines parallel to the border and, like the rings in a tree, mark successive stages in the growth of the scale. Running from the growth center to the margin are four radiating ridges which divide the surface of the scale into four triangular areas. Each of these areas is bounded by one of the four borders of the scale and the areas may be called therefore the cranial, caudal, dorsal, and ventral areas. In the natural condition three of these areas, the cranial, dorsal and ventral, are covered by the overlapping of adjacent scales and only one, the caudal, is visible when the scales are in position in the fish.

The characters mentioned as belonging to the typical scales are common to both of the species under discussion but the scales of each species differ from those of the other in certain characters which enable one to distinguish them.

Among the typical scales there are a few in which the central part of the scale is occupied by an irregularly granular area which has a diameter half that of the scale and suggests a greatly enlarged growth center. Scales of this sort were probably formed after the fish had grown to some size and in place of scales that had been lost. They should not be taken into account in attempting to separate species by the scales.

In all the menominees the growth center is in the center of the scale, midway between the cranial and dorsal borders. In all of them the caudal border is strongly crenated (or scalloped)

and from the crenations well marked flutings converge toward the growth center. In all of them the striations on the caudal or exposed area of the scale are much more numerous near the center of the scale than near the caudal border.

On the other hand, in the whitefish the growth center is in 90 per cent. of the fish distinctly behind the geometrical center

FIG. 2—A typical scale of whitefish (Coregonus clupeiformis Mitchill). This scale is distinguished by its very large, irregular central area. The caudal border is at the left. The scale is viewed as a transparent object and is magnified about ten diameters. From a photograph.

of the scale. The caudal border shows but little trace of crenation and the caudal area but little fluting. Striations of the caudal area are apparently as numerous near the border as at the center of the scale.

The differences between the scales are such that they may be easily distinguished at once by a good hand lens.

Turning now to the salt-fish which were seized as illegal whitefish, we find that in their scale characters (position of the growth center, crenation, fluting, and striation of the caudal area) they agree with the menominees. Twenty-eight of the

thirty-five are wholly typical, i. e., agree with the menominee in all the characters mentioned. Seven (20 per cent.) are not typical in all their characters, but are typical in one or more and are recognizable as menominees. These salt-fish were repre-

FIG. 3—Scales of Saginaw Bay herring (Argyrosomus artedi Le Sueur) and of the blackfin (Argyrosomus nigripinnis Gill), both from Lake Huron. The herring scale is at the left. The caudal borders of both scales are at the left and both are magnified about ten diameters. From a photograph.

sented by but two samples from a keg. Had more than two fish from a keg been available for examination, it is probable that entirely typical menominees could have been found in each keg.

As a result of this examination the salt fish which had been

seized as immature whitefish were returned to the parties from whom they were taken.

In addition to the whitefish and menominees I have examined in the round eleven Great Lake herring (Argyrosomus artedi), seven from Saginaw Bay and four from Lake Erie, and one blackfin (Argyrosomus nigripinnis), presumably from Lake Huron. The blackfin and the Saginaw Bay herring are distinguishable from the whitefish by the scale characters, position of growth center, and striation of caudal area. The Lake Erie herring were of unusual size, between three and four pounds weight and I am unable to separate them from the whitefish.

In conclusion it may be said that the method employed served its immediate purpose of separating the Lake Huron whitefish and menominees, apparently better than any other method available. Any general statement passed on the data at hand must, however, be regarded tentative. Before the method can be generally employed for separating these two species it is necessary to examine a much larger number of fish than were at my disposal. Perhaps a thousand fish from different localities and of different sizes and selected at random from a much larger number should be examined. If they are found to agree with those already examined the method may thereafter be used with confidence for separating the whitefish and menominees.

It is probable that, the method could be extended to the other species of whitefish and herring in the Great Lakes, but the material at my command is not sufficient to warrant any final statement on that point. If the method can be extended to other fishes it may be made of service not only in enabling determination of imperfect specimens for legal purposes, but in making it possible to identify by the scales the partly digested fish found in the stomachs of other animals. It is often impossible to identify these partly digested fish by the methods now in use. To identify them with certainty would add materially to our knowledge of the food habits of our fishes. Even sould the method not prove to have wide application it may still be of value in the identification of fish remains from a restricted locality. It is to be hoped that some one will take up this suggestion and make an extended microscopical study of the scales of the fishes in some one locality.

DISCUSSION.

Prof. Reighard (during the reading of his paper): In examining scales to distinguish whitefish from menominee, it is necessary to neglect the atypical varieties. There are three characteristics that will enable one to distinguish menominee from whitefish: First, the position of the center; second, the character of the striations on the caudal area; third, the character of the crenations of the border. In some species the growth center is in the center of the scale, and in some it is nearer the caudal border, in others nearer the cranial border. Finally in some species the striations on the caudal area are almost confined to that part of the area which is near the center. That is, we find in some species that these striations extend from the growth center to the edge of the caudal area while in other species they are not equally numerous over the whole of that area. These characters serve to distinguish the whitefish from the menominees. The most striking difference between them is that in the whitefish these striations on the caudal area are close together and cover the whole caudal area; that you can see in the photograph—the caudal area is the lighter one of the two. In the menominee these striations are very numerous in the center and hardly exist near the border. The growth center in the whitefish is nearer the caudal border. The crenations at the edge are practically absent in the whitefish, and the flutings running from the crenations toward the center are also practically absent.

President: Does a difference in the age of the fish make any difference in the character of the scale?

Prof. Reighard: I do not think it does. I do not know from the examination of the scales, but from the fact that the scales grow outward from a center you would expect it to be alike all the way out.

Question. Are there any menominees caught in Lake Erie?

Answer. No—nor blackfins—the only fish of the sub-family there are whitefish and herring.

Mr. Meehan: Whitefish, herring and the jumbo herring.

Mr. Clark: Then I understand that the true whitefish has a smooth border?

Prof. Reighard: Yes sir.

Q. And the menominees have a corrugated border?

Prof. Reighard: Yes sir, as the photographs illustrate.

President: Can you state the relative merits as table fish, of these different specimens?

Prof. Reighard: Of course, the whitefish is more esteemed by the people generally, but these jumbo herring in Lake Erie are being sold as whitefish.

Mr. Meehan: Only to a limited extent.

Prof. Reighard: The longjaw is a good fish.

President: The purpose of the inquiry is to see whether all these different varieties should not be specified in a protective law.

Prof. Reighard: If they were I suppose it would be necessary to specify different sizes as being legal for different species. The whitefish grows larger than any of the others. The minimun size of whitefish which may be taken should be specified; the minimun size of herring, of course, should be less.

Mr. Bean: I want to express my pleasure in hearing this paper of Dr. Reighard's and to say that in my judgment this society and its associates could perform an excellent service for the protection of fishes of all states, by getting into the laws a clear definition of what the fish really are; for instance, take the pike-perch, that is protected in many states during the spawning season. Now there are other fish closely related to the pike-perch, especially the blue pike. Is it the intention of the law to protect that fish or not? In New York the question has come up practically. Seizures have been made of blue pike as being pike-perch. It seems to me that the services of this society and of scientific men generally could very well be lent toward the interpretation, first, and the unifying afterward, of the laws upon the statute books. What I mean is this: You want to

protect the pike-perch. Do you wish to protect only the common glass-eye, wall-eye, or do you mean to protect its allies, many of which are just as good as the common pike-perch? Clearly the intent of the law in New York was to protect the whole genus. Whatever we can do to introduce in to the laws such explanations of the term pike-perch as will lead to the protection of all the fishes of the genus, would be a great gain for the cause.

Mr. Meehan: I fully agree with what Dr. Bean has said. We have had great difficulty in our own state in several particulars—not in reference to the pike-perch, because it happens that in our law we did that—we say pike-perch, wall-eyed pike, commonly known as jack salmon, wall-eyed pike, and blue pike—they are all mentioned separately—but it often happens that in our laws mention is made of a particular species of fish by some common or local name, and there are perhaps two, three or four species, and it makes it a little difficult to understand whether they can be enforced or not. We had one forcible illustration of that in the question of terrapin, in our state, which caused a good deal of laughter and cussing besides. Some gentleman from Pennsylvania introduced a bill into the legislature for the protection of terrapin, a couple of years ago, and before very long the query arose all over the state: Is the snapping turtle to be protected, is the mud turtle to be protected? Because strictly speaking the whole class of terrapin would include those two. Finally we had to go to the attorney-general to get a contorted opinion, so that the snapping turtle should not be protected by the act. Dr. Bean's proposition seems to be sensible and timely.

Mr. Titcomb: I want to concur in what Dr. Bean and Mr. Meehan have said. When I was commissioner in Vermont for twelve years, we had the whitefish protected; but the whitefish in our lakes differed. In Lake Memphramagog as I remember, we had the menominee whitefish, and in another lake we had the labradoricus; and in Lake Champlain we had the true whitefish to some extent. But it was understood that the whitefish was protected as a whitefish. It seems now that we have got to fix our laws so that all these whitefish can be embraced prop-

erly, and it should be so worded that we are not obliged to make ichthyologists out of each one of the commercial fishermen—we have got to get some common names that will identify the different fish properly and have them plainly described in the laws of the different states.

Mr. Seymour Bower: It seems to me a great deal of confusion and uncertainty would be avoided if, whenever a law is enacted for any kind of fish, the scientific name followed the common name. You won't find that in any of our laws, and many cases that have been tried in this state have fallen through because only one of a number of common names was given; and there are a number of local or common names for nearly every kind of fish. Mr. Lydell was a witness in a case which fell through on those very grounds. Certain persons were arrested for catching black bass, and the defense was that they were not black bass, but "river bass"; and the defense made the jury believe it and the case failed. Now if the scientific name had been inserted in the statute they could not have evaded the law on any such pretext as that.

PROTECTION AS AN AID TO PROPAGATION.

BY SAMUEL F. FULLERTON, ST. PAUL, MINNESOTA.

Mr. President and gentlemen of the American Fisheries Society: The subject that I am asked to write a paper on—"Protection"—is so closely allied with "Propagation" that it is a very difficult matter to separate the one from the other; alone either is worthless. Protection is just as essential as propagation if we would reap the benefits from the money and labor expended in the propagation of our fish.

I need not relate what every thinking man knows to be a fact and that is our fish are disappearing from the Great Lakes. Every housewife is reminded of that fact when she calls up the fish dealer, by the *price*—that great barometer of supply and demand.

Now, when the American people are confronted with a problem they naturally ask what is the cause. Are not the waters in the Great Lakes just as pure as they were thirty years ago? No known disease has destroyed these fish. The government has been most liberal and year after year has supplied these waters with millions of fry. Have the States bordering on the Great Lakes, whose duty it is to look after the fish and protect them, done their duty? There is only one answer, an emphatic "No". They have not appreciated the necessity of taking care of that which was intrusted to their keeping for the benefit of all the people.

Efforts from time to time have been made to get the States interested. I have attended three meetings in Chicago, myself, called for the purpose of arousing the States to action. Resolutions were passed and speeches made but the matter ended when the meetings adjourned. There is only one solution—FEDERAL CONTROL.

Now, I do not want to say one word that would in any way detract from the splendid work done by the United States Fish Commission and the different State Fish Hatcheries and the men in charge of same, but I do claim that we do not get the

results we are entitled to from the amount of fry propagated and distributed.

Take for example one United States Station located at Duluth, Minnesota. The amount of whitefish and lake trout fry distributed during the last ten years from that station alone was 228,808,626 (that does not include the blue-fin whitefish, pike-perch and brook trout) and I am positive that nearly all of those young fish were deposited in the Great Lakes; in fact, the great bulk of them went into Lake Superior.

Now, with intelligent planting and proper protection, aided by the natural increase, we ought to have good fishing in Lake Superior. I know the other lakes in the Great Chain have been treated as liberally and they, also, ought to show results. Not only have the Great Lakes suffered by the criminal policy pursued by the States, whose duty it is to protect, but that splendid fish, the shad, is disappearing from the same cause.

Twenty years ago in the city of Duluth, Minnesota, you could get all the whitefish you could carry home with you for five to seven cents per pound. Today you are a lucky purchaser if you get any, but if you do, you will pay from fourteen to seventeen cents per pound and then you will have to be careful that you do not get Winnipeg whitefish instead of the Lake Superior. While the lake trout are not so scarce nor the price so high, they are not by any means so plentiful as they were twenty years ago—all because we have been criminally careless. I just read a dispatch from Ontonagon, Michigan, which I have inserted in this paper and which bears out what I have been saying in regard to the scarcity of the fish in the Great Lakes:

"A large Lake Superior fish company, operating at Ontonagon, has suspended operations for a month in the hope that whitefish and trout then will be found running better. The lifts have been light this season, during the last few weeks especially, and the business has not been profitable. Similar complaint comes from other ports on the south shore of Lake Superior. Poor catches are reported from Marquette and Grand Marais, while instances are noted where commercial fishermen have transferred the scene of their operations to Minnesota waters on the north shore. At Manistique, the Coffey fleet of three tugs has been laid up for the season. The fishing was poor last year and im-

provement was expected this season. But the contrary is the case."

Why, gentlemen, what would you thing of a farmer, who, after carefully attending to his cows all winter, giving them the best of care, when those cows had their young would turn the young out in barren pastures without food, shelter or water; or the poultryman who watches his incubator through the twenty-one days of incubation, after the young were hatched would turn them out to be a prey for hawks, weasels and all other enemies of bird life. You would say that the dairyman and poultryman were crazy. Well, just as crazy things are done in the protection of our fish. The fish culturist selects with care his breeders and after fertilizing the eggs, watches them during the period of time required to hatch, feeds them carefully until the time comes to plant, when they are turned over to the man who distributes, either in a car used for that purpose or in cans. If intended for the Great Lakes, they are placed on a boat running from eight to sixteen miles an hour, dumped from the gangway without any regard to whether the water in that part of the lake is suitable or not. If for the inland lakes, they are taken to the nearest place on the lake from the railroad station and there deposited, regardless—the only condition that there is water.

Why, gentlemen, I have seen twenty cans of pike-perch or wall-eyed pike fry, which were sent by the United States government to a lake in our state, met at the depot by a committee, who with team took them to the lake, only about one-half mile from the village. Instead of taking the fry out in the lake, they dumped the whole twenty cans in a creek that runs under the road which divides the two lakes, where the fry was intended for. That creek was filled with shiner and chub minnows, and the way those minnows went after that pike fry was like a hungry tramp after a pie—"the kind that mother used to make." I don't believe that in one hour there were 1,000 fry left of those twenty cans. The committee who met those fish ought to have had instructions where to plant them and how to plant them. This is not an isolated case, and I have no doubt that the members here present who are engaged in the work have experiences

to relate where fry might better have been dumped in the gutter than taken to the lake or stream.

A short time ago one of our wardens at the city of Minneapolis, Minnesota, seized several barrels of fish, mostly lake trout. They were shipped from a neighboring state to my own. There were over three hundred of those trout that would not average one pound and several that weighed less than one-half pound. Now, what is the use of going to the expense of propagating lake trout and whitefish when fishermen are allowed to catch and sell fish of this size? They don't do it in Minnesota. Our law is 2 pounds undressed, 1½ pounds dressed. After the seizure, I wrote the proper authorities to take the matter up with the shippers, whose cards we took from the package, and offered to go and testify if necessary. So far, nothing has been done that I have heard of, but hope the parties responsible will be brought to trial and a lesson taught them so that in the future they will be good. The great trouble with us as a people, we allow our greed for gold to blind us, but, after the fish have disappeared, then we wake up and do things that should have been done years ago.

In states where separate boards exist, one for the propagation of the fish and another for the protection of the game and fish, the best of harmony does not always prevail between these two boards, but they ought to work hand in hand because to have complete success both must work together. Very often politicians interfere with the work and ruin the labors of the fish culturist. Fortunately, our fish culture work has not been interfered with much by politicians but the protection, which must go hand in hand with propagation, has, and to that extent we have suffered.

REMEDY.

A proper method of distributing the fry. They ought to be placed in the water as near as possible to where the parent fish would select for their spawning ground. A Federal Law and a treaty with the Dominion of Canada, making a uniform closed season on the Great Lakes so as to protect those fish in the spawning season. A license system for all market fishermen and a rigid inspection of their catch. No whitefish or lake trout

allowed on the market in any state less than two pounds undressed. A sufficient number of boats owned by the government of both countries to look after the planting of the fry and see the young are placed in the most natural surroundings. Those boats to patrol the lakes where fishing abounds and their duty to not only see that all fishermen are licensed and that their catch conforms to law but that the exact spawning grounds are located and no fishing allowed thereon, except for propagating purposes. That no fish be taken for their spawn except under the direct supervision of the proper authorities. That no gill nets be allowed during the time fish are taken for their eggs. That all fish not "ripe" or those already spawned be returned to the water with as little injury as possible. That the utmost care be exercised in the selection of the men in charge of those boats. They should be honest, fearless and with ability to enforce the law without fear or favor.

This applies to the Great Lakes or to our commercial fishing but the problem in regard to our inland lakes is just as trying. Care is not taken. When the fry are planted, people are allowed to catch any and all kinds regardless of size. Even the spawning seasons are encroached upon, but especially is this true in regard to our Great Lakes and our only salvation is *federal control*.

This Association ought to go on record, not simply pass resolutions (while good in themselves as far as they go) but each state representative should go to his home determined to get congressmen and senators at Washington committed to this proposition. Show them how our fish are disappearing, not through any fault of the propagation but through the poor policy, or no policy, of the states bordering on the Great Lakes. Either put no fish whatever, in these waters, if they are not protected or else change our policy, for I firmly believe that we can never do anything with the individual states. So our only salvation, if we would save our fish, is by the Congress of the United States first making a treaty with Canada, for any scheme that leaves out Canada, as far as the Great Lakes are concerned, would not be feasible. Then after the treaty is made, let the United States, with the co-operation of the Dominion, assume control of not only the propagation but the protection and I predict here before this convention that we can have our old time fishing restored in

the Great Lakes, not only to what it was twenty years ago, but with the added knowledge that has come to the Fish Culturist, an increase of a thousandfold.

DISCUSSION.

Mr. Titcomb: Do I understand from Mr. Fullerton that he does not think the fish distributed in the Great Lakes are properly planted?

Mr. Fullerton: Yes, I do; I said they were not protected.

Mr. Titcomb: Then you had reference to the inland lakes where they are not properly planted.

Mr. Fullerton: I refer to the inland lakes. I do not know very much about the planting of the Great Lakes at all.

Mr. Titcomb: The government gives the fish away and people are furnished with minute instructions as to what to do, but people do not read their instructions. Unqestionably, it would be better if the states and the government could go to the expense of planting those fish themselves in all public waters, but if we plant all the fish in inland waters that are now delivered to applicants, it will probably cost twice as much as it does at present.

Mr. Clark: Ten times as much.

Mr. Lydell: Twenty times as much.

Mr. Clark: Yes, I think it would be twenty times as much.

Mr. Titcomb: Then that means it is prohibitive and you must keep up a campaign of education. The people will learn in time. Federal control is the keynote of protection on all interstate and international waters and until obtained you cannot protect the fish properly. I want to bring up one illustration because the United States Bureau of Fisheries had boasted for years of its great results from the propagation of shad, and for nearly twenty years after such propagation was begun there was a steady increase in the commercial fisheries; during the last four years the commercial shad fisheries have gone down very rapidly; when they go down so fast you may know that the end is coming, just as the Atlantic salmon fishery came to its

end. That is largely due to the fact that with the improved appliances and new methods of pound net fishing, the shad are taken before they get into fresh waters,—they are caught in the lower bays, in salt and brackish waters. States that propagate shad are powerless and the bureau is powerless because we cannot get the fish from which to get the eggs. For instance, at the mouth of the Susquehanna about 8.000,000 eggs were collected this year, where some seasons over 100,000,000 have been taken. That illustrates the conditions, which can only be corrected by federal control.

Mr. Fullerton: That is the only salvation.

Mr. Titcomb: Unless the millenium comes and all states co-operate.

Mr. Fullerton: We will never get it.

Mr. Clark: I rise to disagree with our friend Fullerton in the statement that the fisheries in the Great Lakes are decreasing. I do not believe it at all; the figures will show that in certain localities our fisheries are holding their own, if not increasing.

In regard to the method of control, I do not entirely agree with Mr. Fullerton. However, I not only fully agree with him on the license system, but I went on record regarding this subject thirty years ago, and I have since been much interested in the movement. I would not only have a license system for the lakes, but for the rod, not only to create a revenue but that the offender may be recorded; I would rather have the penalty the revocation of the license than a fine of $25. You revoke a man's license for from one to six months and you have got him. Therefore I am in hearty sympathy with anything of this nature. I think that there should be vigorous and persistent enforcement of the laws regarding the catching of small fish and the pollution of the waters. If the sewage could be kept from the waters we would have a great many more fish. We know of localities where not only the feeding grounds but also the spawning grounds formerly sought by the whitefish have been covered up, thus driving the fish from their natural habitat. The Great Lakes in

many respects do not today begin to compare with what they were thirty or forty years ago.

Mr. Meehan: I must disagree with Mr. Fullerton to some extent with regard to the Great Lakes, at least so for as Lake Erie is concerned. I think that statistics that we have will show that in some particulars there have been actual increases in the fishes. Take the whitefish, for instance: a number of years ago we had a large number of whitefish and then artificial propagation was begun, but just before it was begun the whitefish almost disappeared. They had been caught with all kinds of nets, there was no close season; with the result that it did not pay to put out nets regularly for them. We have given a certain amount of protection, we have a close season, we have certain meshes required, and we have been propagating heavily. This year we have begun to take whitefish again in Lake Erie in quantities. Last Friday for instance, one boat brought in 1,500 pounds, which is a pretty good record for a starter on this work. So the other boats yesterday and the day before came in with good catches of whitefish.

The bluepike have been largely on the increase in the catch and character of the fish for the last six or eight years for us in Lake Erie.

I agree that three-quarters of the fish probably that are planted in our inland waters are not properly planted. Mr. Fullerton says he did not mean the Great Lakes. I think there, as a general rule, they are planted properly, as the states generally do their own planting; but in the interior waters people do not follow the instructions given them.

I agree with what Mr. Titcomb says in regard to the disappearance of the shad. They are falling off rapidly. Our own experience has been that where we used to have 25,000,000 and 30,000,000 eggs a year, this year we only got a little over 3,000,000 in the Delaware river. I think not only are they caught in the bay improperly, but, as possibly Mr. Titcomb does not know, that one or two of the states bordering on the Delaware river, passed laws which cut down the mesh to next to nothing and made the open season for catching the shad throughout the entire year, except two months. The shad can-

not stand that; that alone would have the tendency to destroy the shad fisheries in the river.

We had another drawback this spring in the very cold weather, which probably lessened the shad in our river. It is a very serious matter because not only are the shad decreasing in the Delaware, but I believe also in all the rivers along the Atlantic Coast. Is not that true?

Mr. Titcomb: In North Carolina on the Roanoke River they passed a law prohibiting the use of pound nets in certain parts of the lower bays. As a result the Bureau hatched over 20,000,000 eggs at the Edenton station on the Albemarle Sound the last season, as against an average of from 3,000,000 to 5,000,000 during the years before the law went into effect.

Mr. Meehan: That shows what can be done by proper protection. I think the real solution of the problem lies in federal control. This society passed a resolution last year recommending federal control, and in conformity with that resolution in my report goes the recommendation to the legislature, that Pennsylvania with the concurrence of other states will cede to the United States federal control on the Great Lakes and on rivers of the border states.

Mr. Nevin: For the last two or three years fishermen have told me that they have seen more fish near the surface of the water in Lake Superior than they ever saw before. They have seen schools of whitefish and lake trout so large that they did not think it possible that so many fish were in the lake. There was a time some thirty years ago when there was no more fish caught in the waters of Lake Superior than there have been the past two seasons. The water is so clear that, during the summer months, when there are many nets in the water, the fishermen tell me that they see thousands of fish feed along and pass by the nets. If the fish are coming in full force straight for the net they will rise and go over it. I claim that the fish have seen so much twine in the water that they are becoming educated and keep shy of it when possible. Any fisherman knows that fish do not run into nets during the day time and that there are not many fish caught during calm, still weather; also, they do not catch

as many fish in the light of the moon as they do in the dark. Fishermen tell the same story from the Atlantic to the Pacific.

Mr. Lydell: I would like to talk about seventeen hours on this subject now, but I do not see as there is any use. We are doing the best we can to educate the people as we go along to plant fish right. I know the people of Michigan are getting their instructions with every can of fish we ship to them, and I think most of the people in Michigan know how to plant fish now.

Mr. Gunckel: I remember a few years ago down in Montgomery County, Ohio, several cans of fish were sent to the farmers who planted them in front of their farms in a stream which is high in the spring and lower in the summer. They were planted there in the early part of the season and in the latter part of the summer the hole was dry and the stream was dry. The next year when the rains and freshets came the people asked where the fish were. But there was no water and no fish. That is something that we see all through Ohio. I thing Mr. Fullerton is correct in saying that the people do not use enough care to see that the fish are properly planted, merely sending cans of fish to a committee of farmers or perhaps to a committee of fish-worm anglers; and they distribute them in the little streams in the interior, and never watch them, never see that they are even in deep water. I thing that should be remedied.

While on the floor I wish to ask to be excused. I rode five hours to come here merely to pay my respects to this society and show that I am still a member. I wish to take the next train so that I can go back to my work and not be missed. That is the way a fisherman always does.

President: Of course we will excuse Mr. Gunckel and allow him to go to his work, but he will be missed.

Mr. Boardman: I would like to ask to what extent the pollution of streams affects the propagation and the growth of the fish. I have always considered that the streams of New England which were badly polluted had a bad effect on the fish; but I came from a short trip in Illinois and seeing how badly the water is polluted, and how plentiful the fish are, I have come to the conclusion that pollution of the waters has not so much to do

with the quantity of the fish as some people think. I have changed my opinion, for certainly, in spite of the filthy-looking water the fish are extremely plentiful, and especially in Spring Lake.

Q. They are bass?

A. Large mouth. We always considered factories polluting streams had driven out our bass, but I have changed my opinion, and I would like to know whether I am right in changing it or not.

Mr. Atkins: What polluted the water?

Mr. Boardman: About everything, I should judge. I understand they turn the sewage from Chicago into the Illinois river largely through the drainage canal, and I should think everything that could pollute a stream was there—from the looks of it.

Mr. Atkins: It makes probably an immense difference what sort of pollution you put into the water. It has been found in Europe to be an excellent practice to manure ponds, so that if you have cow-yards and stockyards draining into your streams, according to the practice in many parts of Europe, that would be a decided advantage to the fish.

Mr. Titcomb: What kind of fish?

Mr. Atkins: Carp. (Great laughter.)

And at the same time it might be very deleterious to have the water pollution or refuse from paper mills or chemical works, and it seems to me that the whole question is one that needs to be thoroughly investigated, and we have hardly begun it. There needs to be a commission at work in every state investigating the condition of the water, the causes of any pollution that they may find, and the specific action of the particular sort of pollution upon fishes.

Mr. Clark: A word or two in regard to pollution. The proof seems positive that pollution is highly detrimental to the waters of the Great Lakes for whitefish. At Alpena on Thunder Bay river fifty or sixty years ago, whitefish weighing from 5 to 10 pounds were caught, but twenty-five years ago no whitefish were

taken from the river, nor until within a distance of six or seven miles from its mouth, as can be testified by a gentleman now present (Mr. Wires). Today the men we have there do not see any caught within nine or ten miles of that river, and the bottom of the bay is literally covered with old bark and sawdust. Now, if it was not these polluting substances that came down the river from the mills, that drove the whitefish out, pray tell me what it was. I know there were many caught from the river fifty or sixty years ago, as the evidence is indisputable. If it was not the pollution that drove them out, what was it?

Mr. Nevin: Do coal ashes have any effect?

Mr. Clark: I think any pollution in the water will hurt the whitefish more or less, and there should nothing go in that is in any way harmful.

Mr. Titcomb: This is a subject upon which we could receive testimony continually for a long time. I am sorry that Mr. Marsh is not here from the Bureau, because he has been making some laboratory tests with water taken from sewers and from rivers below the tail-races of mills, and he has by that means discovered the effects of different kinds of pollution. I think that most of the so-called pollution referred to in the Illinois river, is the wash from the farmlands and is not very injurious to fish; and I am told that when the cornfields are overflowed the carp and big mouth bass grow best, and they appear to stand any amount of muddy water. But our pollution in New England is largely from factories in clear water streams, and that stuff kills the fish. On the Delaware river this season I learned that the oil steamers come in at Newcastle, Delaware, in ballast with water; that while it is contrary to law to empty that water out after they arrive at port, they do violate the law, and that water is so polluted that it kills the fish. In the vicinity of the vessel schools of young shad have come up on shore, dead. Near the Du Pont powder works and in other places whole schools are killed by direct pollution in that way.

Mr. Boardman: I have listened to a good many discussions about carp and I asked a commercial fisherman at Spring Lake what he thought about carp, and he said they certainly lessen

the number of other fish, but he thinks that the other fish were afraid of the carp for a while but now they seem to grow together just as other fish do; that the carp do not fight them any more and that the other fish are increasing, and this year their catch has been the best they have had for a number of years, in the vicinity of Spring Lake.

Dr. Bean: I do not like to prolong this discussion, but the subject is one of so great importance to fish culturists that I would like to say just a word. I understand that the paper deals mainly with propagation and protection, but the associated question of pollution is one so near to the results at which the fish culturists aim, that we cannot consider the two without also mentioning the third.

President: That would probably come under the head of protection from pollution anyhow.

Dr. Bean: It appears to me that that is one of the most important subjects with which we have to deal at the present time, not only on the part of the federal and state governments but on the part of the private fish culturist as well. To illustrate how destructive the matter of pollution may become (and the instance which I have in mind is a thing which has been observed in Germany and reported upon by an eminent bacteriologist, Dr. Hofer), I would like to refer to the washings from manure heaps and pig-sties and other domestic arrangements which are turned into streams supplying trout ponds. That kind of pollution, according to the researches of Hofer and others, has caused the disease which we have recognized in our own country only too seriously in fact, as the boil or ulcer disease, especially among the brown trout, and to some extent among the brook trout of this country. Prof. Hofer had brook trout suffering from this disease under observation in Germany, and his paper relates to ulcer disease among brown trout mainly, but also among brook trout. Now this very source of pollution has, in one state, to my own knowledge, reduced the stock of one particular species of trout from some hundreds of thousands to a few thousand in a very short time. It is a very serious matter then for us to consider and I do not believe that it has received the attention from the states and the federal government to which it is entitled, up

to the present day. I do not mean to find fault at all. We have been so busy getting out fish that we have not stopped to think about the enemies and the diseases which retard our work; but we have got to do it now; we cannot afford to lose thousands of dollars worth of stock in a season; and we must all get to work and talk to one another and talk to the people about these things and tell them what to do, if we know anything that can be done, and we do in some cases. I do not wish to take up your time, but I merely wanted to state that it appears to me that Mr. Fullerton's paper starts a subject on which we ought to talk for hours and days, and continue to talk for years to come.

Mr. Clark: In connection with Mr. Fullerton's paper, and to substantiate the statements I have made in regard to the fish and fisheries of the Great Lakes not retrograding, and with due respect and regard to the programme committee, I would like, if it is agreeable to the president and members, to call for a talk and some charts that Mr. Seymour Bower is intending to present. The subject is, I understand, right along the same line with the matter now under discussion.

Mr. Seymour Bower: (Speaking.) A few days ago I had occasion to refer to the statistical records on file at the office of the Michigan Fish Commission, and while delving through these records for certain information, a number of points were developed that it seemed to me would be of interest to the members of this society and worth publishing in the annual report. This is my excuse for appearing before you in connection with a subject that is acknowledged to be pretty dry, the subject of statistics.

For the past fifteen years, or since the beginning of 1891, the Michigan Fish Commission has employed an agent who devotes nearly his entire time to the collection of statistics covering the commercial fishing industry of Michigan waters of the Great Lakes. This agent visits each fishing station at least once every calendar year and collects the figures for the preceding calendar year. The figures are obtained by personal interview and by inspection of the records and books of every fisherman, the latter being thrown open to him freely for this purpose. By reason of this free access to all of the records, and taking into consideration

the personality of our agent, Mr. Moore, who is unusually painstaking and thorough in every detail of his work, we believe that the results obtained are thoroughly reliable, in fact that these statistics are as accurate as it is practical to make them. Realizing that the subject is a pretty dry one, and in order to relieve the monotony somewhat as well as to emphasize comparisons, I have made use of a number of line charts, as I call them.

These tables and charts, then, represent the fisheries data of the Michigan waters of the Great Lakes from 1881 to 1904 inclusive, 1904 being the last year for which we have complete returns, all taken by the same man and without any change whatever in classification.

The figures in detail for whitefish are as follows:

(At the suggestion of Mr. Bower the line charts referred to are omitted from the report, but the detailed figures are given in full.)

WHITEFISH.

Year	Total Catch, Pounds	Total Value
1891	8,110,000	$351,196.00
1892	6,347,000	258,011.00
1893	5,345,000	231,189.00
1894	4,470,000	163,813.00
1895	3,353,000	130,811.00
1896	3,783,000	141,750.00
1897	4,639,000	186,777.00
1898	4,102,000	170,245.00
1899	3,640,000	188,586.00
1900	3,460,000	185,010.00
1901	4,173,000	236,909.00
1902	5,371,000	307,860.00
1903	4,508,000	276,638.00
1904	4,197,000	270,262.00

The first table represents the catch and value of whitefish. All comparisons are made with the year 1891, which I take as my basis of comparison.

In the year 1891 the total catch of whitefish was 8,110,000 pounds—this refers only to Michigan waters of the Great Lakes—of a total value of $351,196. That is the high year. The catch has not been as great as that in any year since. It fell off rapidly until 1895, which is the low year, not only in the catch, but in

the value of the fish. From that time on the catch has increased as a whole until the total of the last three years of the period ending with 1904 was 2,800,000 pounds more than for the preceding three years, and for the last five years it was over 2,000,000 pounds greater than for the preceding five years.

The values have increased faster in recent years than the catch. The total value for 1902 was nearly equal to that of 1891, although the catch was considerably less. The claim that whitefish have been nearly all cleaned out of the lakes is not true, at least so far as Michigan waters are concerned. The catch has held up well for ten years while for the last three years a marked increase is shown.

Mr. Fullerton: Can you assign any cause for the increase in price?

Mr. Bower: Everything has increased in price; meats, for instance, and nearly all food staples. Moreover the producing area for fish remains stationary, while in good times the demand increases with the increase in population. Going back a little, however, we fiind an exception to the rule. Ordinarily when any commodity is scarce on the market the price is enhanced, but we find that in some of the years in which we had the smallest catch of whitefish the price was lowest per pound. It seems that for some reason or other—perhaps on account of "hard times"—the price affected production rather than production the price. In other words, values were so low that fishing was more or less unprofitable.

Secretary Peabody: Was not that because the Lake Superior whitefish was not educated in those years?

(Laughter.)

Mr. Bower: Possibly, but the exception applies not to whitefish alone, for the years 1895 to 1897 were the low years with all kinds of fish, not only in catch but in value. Beginning in the late 90's, however, there was a gradual increase in the total value of the catch of nearly all kinds, a conspicuous exception, however, being the sturgeon.

The next table refers to lake trout.

LAKE TROUT.

Year	Total Catch, Pounds	Total Value
1891	9,132,000	$375,200.00
1892	8,860,000	358,598.00
1893	8,948,000	366,489.00
1894	7,291,000	243,261.00
1895	6,293,000	234,311.00
1896	6,900,000	240,902.00
1897	6,580,000	246,121.00
1898	6,495,000	235,915.00
1899	6,505,000	292,852.00
1900	6,458,000	282,711.00
1901	7,388,000	337,872.00
1902	9,363,000	431,630.00
1903	9,635,000	463,690.00
1904	11,638,000	504,696.00

You will notice that 1895 was the low year both in catch and value of lake trout. Then the catch held its own pretty well until 1900, increasing from that time to 1904, when not only the catch but the value was greater than for any year of the fourteen-year period, and probably greater than at any time in the history of commercial fishing in Michigan.

We account for the increase in catch of lake trout to some extent by the increased amount of fishing in deep water for siscowet trout in Lake Superior, which is rather expensive and when prices are low rather unprofitable.

Mr. Clark: I would like to ask, Mr. Bower, if this increase is not due in a measure to the increased output of fry, more particularly of the United States hatcheries as well as from Wisconsin,—the output being greater in recent years.

Mr. Bower: I have no doubt that the increased output of the hatcheries is also an important factor in the increased catch.

Mr. Clark: An increase of 50 per cent. at least or more than that.

Mr. Bower: The figures in detail of the herring catch and value are as follows:

HERRING.

Year	Total Catch, Pounds	Total Value
1891	7,823,000	$117,319.00
1892	5,564,000	71,979.00
1893	10,178,000	159,313.00
1894	8,825,000	112,046.00
1895	10,512,000	101,618.00
1896	12,115,000	92,012.00
1897	12,958,000	98,510.00
1898	14,937,000	143,439.00
1899	17,567,000	193,000.00
1900	13,068,000	172,250.00
1901	14,865,000	287,850.00
1902	19,112,000	285,875.00
1903	15,767,000	305,036.00
1904	19,927,000	332,831.00

Nineteen hundred and two was the low year; then the catch fluctuated, but you will notice that in some years when the catch was low the price was even still lower proportionately. Very likely, however, the fish were just as abundant as they were in later years. The small catch does not necessarily indicate scarcity but rather that the price was so low that it was unprofitable to fish for them in some localities. Then you will see that the catch increases rapidly down to 1904, when it was the largest in the history of commercial fishing in Michigan, not only in pounds but in value,—nearly three times as large as it was in 1891.

Mr. O'Brien: Are not the meshes of nets now used smaller than they were in nets used in 1891?

Mr. Bower: They are for Green Bay, but elsewhere the sizes are the same as they have been as far back as 1889, except from 1897 to 1899. In 1897 our general law on meshes was so amended as to increase the size of large meshed pound nets one-half inch and large meshed gill-nets one-fourth inch, but this amendment was repealed two years later, in 1899, leaving the sizes the same as since 1899, except for Green Bay.

Mr. Nevin: How was the fishing reported on Lake Michigan this year?

Mr. Bower: I have not heard.

President: Is not there a greater demand for herring than there was fifteen years ago?

Mr. Bower: There is a greater demand for all kinds of fish.

The next table shows the catch and value of pike-perch or wall-eyed pike.

PIKE-PERCH OR WALL-EYED PIKE.

Year	Total Catch, Pounds	Total Value
1891	2,791,000	$92,623.00
1892	2,356,000	84,285.00
1893	1,861,000	76,717.00
1894	2,824,000	75,056.00
1895	2,134,000	59,845.00
1896	2,121,000	69,106.00
1897	2,432,000	82,982.00
1898	3,113,000	98,356.00
1899	2,816,000	115,176.00
1900	1,741,000	82,927.00
1901	1,713,000	87,412.00
1902	2,289,000	129,540.00
1903	2,904,000	174,609.00
1904	2,697,000	168,306.00

Although there was a general slump in values in the middle 90's, the catch of pike-perch fluctuated less perhaps than most of the other kinds. You will notice for the year 1903 the total catch was the largest in any of the fourteen years with one exception; and the values of 1902, 1903 and 1904 are much greater than for any similar period of the fourteen years.

The next table represents the common or yellow perch.

PERCH.

Year	Total Catch, Pounds	Total Value
1891	2,017,000	$21,192.00
1892	2,560,000	28,758.00
1893	2,622,000	30,374.00
1894	2,785,000	27,435.00
1895	2,437,000	25,093.00
1896	2,010,000	19,393.00

Year	Total Catch, Pounds	Total Value
1897	2,091,000	25,173.00
1898	2,772,000	34,192.00
1899	3,458,000	41,473.00
1900	4,031,000	48,202.00
1901	4,155,000	62,422.00
1902	3,300,000	63,622.00
1903	3,107,000	73,292.00
1904	2,474,000	59,421.00

You will notice that 1896 was the low year for both catch and value, also that during the last five or six years both catch and value are quite largely increased. This increase in the catch of perch, also of suckers and some other kinds of rough fish, is due to some extent to the introduction of submarine trap-nets about eight years ago, the use of which was abolished in this state beginning with January 1, 1905. From 800 to 1,000 of these nets were employed at that time.

Mr. titcomb: Do you propagate perch now?

Mr. Bower: No sir; not the common perch.

Mr. Titcomb: Do you believe it ought to be?

Mr. Bower: If it is a practical success, yes, sir.

Mr. Titcomb: It is one of the easiest fish to propagate we have.

Mr. Meehan: We propagated 62,000,000 this year.

Mr. Clark: This was the white perch?

Mr. Meehan: No, the yellow.

Mr. Bower: The next table refers to suckers.

SUCKERS.

Year	Total Catch, Pounds	Total Value.
1891	1,392,000	$17,132.00
1892	2,352,000	27,701.00
1893	3,114,000	32,670.00
1894	3,600,000	34,054.00
1895	3,900,000	35,035.00
1896	1,900,000	20,067.00
1897	2,162,000	24,428.00
1898	1,833,000	21,183.00
1899	2,017,000	27,075.00

Year	Total Catch, Pounds	Total Value
1900	2,650,000	34,167.00
1901	2,751,000	47,665.00
1902	3,925,000	68,714.00
1903	5,432,000	99,061.00
1904	5,000,000	81,814.00

You will notice that the crop of suckers in Michigan in 1903 and 1904 was very large—must have been more than one born a minute. (Laughter.) Suckers were probably as abundant in 1891 as now, but their value at that time was much lower, hence there was less incentive for catching them. If the law prohibiting the use of submarine trap-nets has been enforced since it took effect, January 1, 1905, the catch of suckers and other coarse fish will probably show a considerable decrease since then.

Q. Is not the sucker leading the whitefish now?

Mr. Bower: Yes, in pounds but, of course, not in value.

Speaking of values I want to say that those I have used in all the tables are the prices received by the fishermen. In case a fisherman is also a dealer his fish are valued at what he would pay somebody else for them and not what he actually receives as a dealer. The values are on the lowest basis, the price received at first hand.

The price and value of sturgeon, including caviar, are as follows:

STURGEON.

Year	Total Catch, Pounds	Total Value, Including Caviar
1891	831,000	$47,571.00
1892	501,000	31,817.00
1893	468,000	28,758.00
1894	294,000	17,733.00
1895	225,000	16,712.00
1896	225,000	17,483.00
1897	185,000	19,303.00
1898	237,000	25,931.00
1899	217,000	33,492.00
1900	176,000	24,847.00
1901	132,000	20,697.00
1902	107,000	17,814.00
1903	110,000	18,360.00
1904	101,000	16,800.00

It will be noticed that the sturgeon is rapidly on the road towards practical extermination.

Mr. Clark: It is practically gone.

Mr. Bower: You will also notice that values have increased much faster relatively than the catch. This is due in a great measure to the increase in the value of caviar at first hands; nearly every man that catches sturgeon now-a-days knows how to make his own caviar, and he does so. Although the process is simple and inexpensive, only a few understood it a number of years ago—it was carefully guarded as a trade secret. Fishermen used to receive 15 to 20 cents per pound for the roe whereas now they realize 80 cents to $1.00 per pound for the caviar. The output of caviar in this state in 1891 was about 60,000 pounds, but in 1904 it had dropped to about 8,000 pounds.

The next table covers all kinds of fish not previously classified.

ALL OTHER KINDS, PRINCIPALLY GERMAN CARP, MENOMINEE WHITEFISH, CATFISH, BULLHEADS, SUNFISH, ROCK BASS, GRASS PIKE, SAUGERS, ETC.

Year	Total Catch, Pounds	Total Value
1891	1,557,000	$35,790.00
1892	2,795,000	72,434.00
1893	1,482,000	38,265.00
1894	1,234,000	29,965.00
1895	1,277,000	24,165.00
1896	1,301,000	30,188.00
1897	1,510,000	26,536.00
1898	1,671,000	30,816.00
1899	2,081,000	44,795.00
1900	2,400,000	50,798.00
1901	3,061,000	52,005.00
1902	2,763,000	55,665.00
1903	2,384,000	56,202.00
1904	1,971,000	48,860.00

You will notice the same general condition with reference to the catch of these miscellaneous fish, viz: low in the middle 90's, then gradually increasing. The catch, however, decreased somewhat in the last year or two, during which time probably 50 to 60 per cent. of this class was German carp.

The aggregate catch and value of all kinds of fish are shown in the next table.

TOTALS OF ALL KINDS.

Year	Total Catch, Pounds	Total Value
1891	33,643,000	$1,058,028.00
1892	31,345,000	933,586.00
1893	34,018,000	963,778.00
1894	31,323,000	703,365.00
1895	30,131,000	627,594.00
1896	30,355,000	630,902.00
1897	32,557,000	709,831.00
1898	35,194,000	760,079.00
1899	38,432,000	936,453.00
1900	34,011,000	881,002.00
1901	38,259,000	1,133,839.00
1902	46,242,000	1,461,724.00
1903	43,857,000	1,467,520.00
1904	47,992,000	1,482,990.00

You will see that the combined catch was low in 1894, 1895 and 1896, with the lowest value in 1895, and that is true of nearly all kinds of fish. Then there was a gradual increase until the year 1904 when the total both in catch and value was the highest of any year of the fourteen-year period, and probably higher than at any time since commercial fishing has been carried on in this state.

The next table shows in detail the data with reference to pound-nets.

POUND-NETS.

(Includes trap-nets, fyke-nets, gobblers, and submarine trap-nets, or all forms of nets that take fish by leading them into trap or pound.)

	Total Length of Leader in Fathoms
1891	304,000
1892	245,000
1893	237,000
1894	242,000
1895	210,000
1896	213,000
1897	269,000
1898	268,000
1899	290,000
1900	305,000

	Total Length of Leader in Fathoms
1901	282,000
1902	305,000
1903	341,000
1904	345,000

For a few years after 1891 the use of pound-nets gradually dropped off. The low years were 1895 and 1896, then there was a grandual increase, amounting to 12 per cent. in 1904 over 1891. Probably this increase has been lost by this time, if the law prohibiting the use of submarine trap-nets, effective January 1, 1905, is enforced.

The next table refers to gill-nets.

GILL-NETS.

	Fathoms in Length	Miles
1891	2,363,000	2685.2
1892	2,503,000	2844.3
1893	2,815,000	3198.8
1894	2,795,000	3171.6
1895	2,616,000	2972.7
1896	2,410,000	2738.6
1897	2,456,000	2790.9
1898	2,687,000	3053.4
1899	2,802,000	3184.0
1900	3,051,000	3467.0
1901	3,652,000	4147.7
1902	4,032,000	4581.8
1903	4,213,000	4787.5
1904	4,510,000	5126.1

The use of gill-nets has increased much more rapidly than any other form of apparatus. In no later year has there been a less number of these nets in use than in 1891, and in the last four years there has been a large increase, amounting to nearly 100 per cent. in 1904 over 1891.

The next table refers to seines, the use of which is relatively unimportant.

SEINES.

	Fathoms in Length
1901	8,200
1892	19,800
1893	27,500
1894	35,800

	Fathoms in Length
1895	26,300
1896	22,000
1897	19,000
1898	4,800
1899	5,100
1900	3,700
1901	4,400
1902	4,500
1903	4,800
1904	6,200

The next and last table shows the total investment in lands, buildings, apparatus, etc., for the fourteen-year term.

TOTAL VALUE OF FISHERY LANDS AND BUILDINGS AND ALL FISHING APPARATUS, INCLUDING NETS AND BOATS.

1891	$1,105,000
1892	1,169,000
1893	1,315,000
1894	1,200,000
1895	1,078,000
1896	1,010,000
1897	1,022,000
1898	1,181,000
1899	1,253,000
1900	1,237,000
1901	1,467,000
1902	1,670,000
1903	1,946,000
1904	2,175,000

The general depression in the fishing industry during the middle 90's is shown in this table as well as in the catch, the low years being 1895 to 1897, the figures then increasing until the total value in 1904 is more than double that of 1896.

The total number of men employed increased from about 4,000 in 1891 to about 7,000 in 1904. (Applause.)

Mr. Fullerton: I am delighted to know that we do not need any change in our fishing laws, as the fish are increasing so fast! I am tickled to death to think that our fish are increasing so rapidly as they are! It is gratifying to me to learn that the information that I have been getting from the market fishermen and other people is inaccurate.

Mr. Clark: The increase to a certain extent has been by protection and propagation, and we want to continue it still more thoroughly.

Mr. Brown: Right in this line I want to say that during the last session of the legislature of Michigan we read some of these figures to show the members the importance of the work, the number of people that were employed in the business and the amount of capital invested, and some of the members asked us about the statistics of other states, and we had none. The United States takes them only once in five years and we were criticised for making our own statistics. Now I want to ask if the members do not think that the same sort of statistics and the same methods from all other states would be valuable and help the fishing interests generally. Mr. Fullerton I think, overlooked in his remarks the large increase in the amount of nets and seines that are in use now as compared with a few years since.

Mr. Fullerton: I took that into consideration.

Mr. Brown: And the large increase in the price. I want to speak also about sewage and its relation to pollution of waters. Take the Saginaw river between Bay City and Saginaw where all the ordinary sewage of the city runs into the river, there was never any notice of the stream being depleted until they begun to turn the beet sugar factory waste in, which contains sulphuric acid, lime, etc., and that surely killed the fish. But between November and March of every winter they fish with nets; and in that thirteen miles of river in 1904 the catch was 1,600,000 pounds, of which 535,000 pounds was perch, 777,000 suckers, and then some bass and sunfish, 122,000 pounds, and of course this shows that it is not all pollution that makes a very marked difference in the catch, particularly in the case of rough fish.

Dr. Birge: I should like to call attention to the point that Mr. Brown mentioned, that of the increase in the nets. I wish that Mr. Bower, if he could find time to do so, would prepare a correlation table showing the ratio between some unit of net pounds or whatever he may select, to the amount of fish caught in that year. It seems to me that the showing would be more favorable for the fish than I had anticipated. The pound nets

show apparently considerable increase; the gill nets show an increase of about 80 per cent., as I figure it roughly. The total catch of the fish showed an increase of about 50 per cent. over 1891. Those figures, of course, I want to verify. Now, if one important method of catching did not increase and the other increase was about 80 per cent., in the second important method, then it would seem that the fish are not much less abundant in the lakes now than in 1891—somewhat less abundant. but not greatly so. One who is familiar with the statistics could undoubtedly work out a much closer correlation, and show the significence of these figures as bearing on the relative abundance of these fish at the stations fished by the Michigan fishermen fifteen years ago and at present.

President: I think that all these figures and suggestions lead to this conclusion, especially in view of what has been done in the several states in the way of protection, that there is an increase of fish in the lakes. But if you turn to the protective laws in the several states, while they were in existence in 1891, they were not enforced as well as they are today. Now, I know that Michigan has done better in the last six years than ever before, and I think it is true to a considerable extent in the other states; and therefore if I am right about that it rather strengthens the argument of Mr. Fullerton, that if we would put it under a uniform system, such as federal control, the protection would be far more effective and far more useful than now. But I think that some of these results shown by the chart are due to the protective measures that have already been taken.

Mr. Nevin: Is the two pound lake trout law enforced in Michigan in regard to the protection of the small fish?

President: I don't know.

Mr. Nevin: I know it is not in our state.

Mr. Clark: It is in force in Michigan. The lake trout law is enforced just as well as the whitefish law.

Mr. Seymour Bower: In regard to the immature whitefish our statistical agent is very familiar with the grounds in Michigan; knows just what kind of fish are caught and how they are

caught at every point along our coast line. According to his estimate there are twice as many illegal whitefish caught in Michigan waters today, in number, I mean, as there are legal whitefish —in other words, two-thirds in number of the catch of whitefish today in Michigan waters are illegal fish—and that very materially reduces the weight and value, because most of those fish are salted. As an illustration, last week our agent, while in Toledo, called at a fish house and while there they received a little consignment of whitefish from a village on the east shore of Lake Michigan. It was a small lot, 800 pounds, but there were between 1600 and 1700 fish by count. The shipper received three cents a pound, whereas for a four, or five or six pound fish the price would have been ten or twelve cents a pound. The great curse in the whitefish industry is the catching of the small fish. If that had been checked in the last ten years, the lines on my chart would not go clear beyond the paper. There is not a single commercial fish caught in Michigan where there is so great a percentage of immature, illegal fish taken as the whitefish. The great bulk of over 90 per cent. of the lake trout caught in this state are of legal size according to our agent. But two-thirds of the whitefish by number are illegal fish.

President: Of course, I did not mean that this increase was due to protection alone; but it was taken in connection with the work being done in propagation as well. There isn't any doubt but that the work of propagating whitefish in the last few years has done a great amount of good. We all know around here in Michigan at least, that whitefish have begun to appear where they had disappeared because they had been cleaned out by the net

SOME EXPERIMENTS IN THE PROPAGATION OF RAINBOW TROUT.

BY MR. ALBERT ROSENBERG OF KALAMAZOO, MICHIGAN.

In presenting this paper for your consideration, I feel somewhat diffident, as I have no means of knowing that there is anything new or original in it.

In view, however, of the discouraging work with these fish at other stations as well as ours, and the radical and gratifying results obtained by these experiments, it will, no doubt, prove interesting to those fish culturists engaged in this work.

If you will pardon the digression, I will begin by giving you a short resume of the season of 1904, so that a comparison may be made:

Our take of eggs was	252,000
Loss of eggs was	95,000
Loss of Alevins	81,840
Loss of fry	11,262

The eggs were taken at side of pond, regardless of air temperature, using double pan; lower one containing water. When separated, they were carried in pails to the hatchery, washed, measured, and placed on trays.

When hatching was thoroughly started, alevins were taken up and placed in fish trays. Here they commenced to die in large numbers, when from one to four days old; and all fish culturists, who have had similar experiences can realize the awfulness of picking dead alevins, bursted sacs, etc.

We tried leaving them in tank where they were hatched; but the result was the same—the losses ran from 5 per cent to 100 per cent in different lots of eggs.

The next serious, and to me, new feature, occurred when the sac was nearly absorbed, and the fish were turned out in a tank preparatory to feeding. The little fellows scattered all over and lay on their sides gasping—only a few swimming naturally. For want of a better name, we christened these "side-wheelers." The losses in batches affected in this way ran about 90 per cent.,

and, strange to say, the best looking fish were attacked in this way.

As we are producing these fish for commercial purposes, a very serious condition confronted us.

I attributed these discouraging results to the following causes:

Loss of eggs caused by chilling.

Low quality of eggs and fish caused by over feeding stock fish and the nature of their food.

Acting on these theories I took particular pains in the summer of 1904 in the feeding of our stock fish. Having fed hog plucks to our fish, giving the large fish mostly lights, I shifted to sheep plucks, and now use them exclusively. Hog plucks contain too much grease, oil, etc. I also fed minnows, grasshoppers, worms, etc.

As soon as we got through handling brook trout during the fall of 1904, we moved our rainbow stock fish to the breeding pens. In looking over the fish at this time (12-20-'04) found one ripe female, which with a few males I took into the hatchery. Pond water was displaced by using hatchery water, temp. 49. After leaving the fish in the warmer water a few minutes, we stripped the female. This was unusually early for us to get any rainbow eggs, and as we got a few eggs during the month of January, it was an easy matter to follow the development. When the first lot of eggs eyed they were counted and dead ones subtracted, showing 96 per cent fertile eggs. This result was practically kept up with—

Our entire take, which was.....469,000
Our loss of eggs was..... 45,000
Our loss of alevins was.....106,313
Our loss of fry was..... 13,408

Whilst the loss in alevins was still very heavy, we had only two small lots of side-wheelers, and the losses from this cause was small. Eggs taken during the last ten days of the season were taken at the side of pond, weather and water being fine; nevertheless losses in these eggs were heavy, and alevins almost a total loss. Not having any idea of writing this paper at that time I did not keep a separate record of those eggs.

Whilst this was a great improvement, I believed we could get still better results; especially with alevins, and herewith give you results of this season's work:

Take of eggs	561,500
Loss of eggs	57,200
Eggs shipped out	292,000
Loss of alevins	32,603
Loss of fry	12,360

We had no side-wheelers; all eggs were taken indoors, after the fish had been admitted to the warmer water.

In conclusion I will give you record of eggs taken February 5, 1906:

Air temperature, 4 degrees above zero.
Water of pond, 36;
Water of hatchery, 48;
Amount of eggs taken, 187 liquid ounces;
Amount of eggs after eying, 211 liquid ounces.

Our stock fish will not run up a raceway, and we resort to netting them once a week in the early part of the season, and twice a week in February and March.

Out of 230 fish stripped this season, only nine females entered raceway, although water supply is ample.

DISCUSSION.

Mr. F. R. Bassett: I find that they are having more and more difficulty in getting brook trout up to 12 or 15 months old than after that.

From some cause, our greater loss is in fish between one and two inches in length. After they reach two and a half inches in length we seem to have no difficulty whatever in raising them.

Mr. Clark: At Northville reverse conditions prevail. We have no trouble in raising them from one to two inches long; the difficulty is after that. I think that it might be well to work on a co-operative plan. We will grow them at Northville up to one and one half or two inches and let you people raise them after that. (Laughter.)

Mr. Seymour Bower: We will have to form a trust.

Mr. Clark: At Northville when the fish are about two inches in length there is a period of heavy loss, and again when they are a year or a year and a half old we have difficulty with the bacterial disease that was, I believe, originally brought to notice at Northville.

Dr. Bean: And a great many other places.

Mr. Clark: In raising brook trout up to an inch and a half or two inches we have but little trouble. Of course we do not have any difficulty raising the rainbow trout up to four or five inches.

Mr. Nevin: Our trouble in Madison is to raise the trout up to two inches long.

FISHERY LEGISLATION BEFORE THE FIFTY-NINTH CONGRESS, FIRST SESSION.

BY HUGH M. SMITH, DEPUTY UNITED STATES COMMISSIONER OF FISHERIES.

The Congress whose first session was concluded on June 30, 1906, had before it an unusually large number of measures affecting the fishing industry and fish-culture; some of the most important of these were enacted into law, others were favorably reported by committee but failed to secure consideration, while others did not get beyond the door of the committee room.

The personnel of the committees which passed upon fishery legislation in the Fifty-third Congress—the committee on fisheries of the Senate, the committee on the merchant marine and fisheries in the House—included some of the ablest men in both houses. Certain fishery legislation was also considered by the committees on foreign affairs and territories.

All bills affecting fishery matters or relating in any way to the fishery work of the government are referred by the committees to the Secretary of Commerce and Labor and by him sent to the Commissioner of Fisheries for a written report or statement of the position of the government as to the merits of the proposed legislation. Later, public hearings may be held, and the Commissioner or a representative of the Bureau of Fisheries may appear before the respective committees and give testimony or make argument.

It has not often happened that Congress has undertaken to regulate fisheries on the high seas or on the coasts of the states. One of the most conspicuous examples of such legislation was the so-called close time mackerel law, enacted in 1887, expiring by limitation in 1893, and having for its ostensible object the protection of the mackerel *(Scomber scombrus)* during the spawning season. This bill prevented the capture of mackerel by American vessels prior to June 1st of each year, and had the effect of wiping out the southern spring mackerel fishery which

had been prosecuted for many years. As I have elsewhere pointed out*, this legislation could have and did have no appreciable influence on the supply of mackerel, and it is, of course, well known to the members of this Society that the five years of assumed protection were immediately followed by the most marked and long-continued period of scarcity in the history of this fish on the American coast.

I bring up this subject at this time because of the method adopted by Congress to attain the ends sought—a method followed by the last Congress in fishery legislation of an entirely different nature. It is worthy of remark that Congress did not attempt to assume any jurisdiction over the time or manner of fishing for mackerel on the high seas, or within the three-mile limit, or in state waters, and thus avoided an important constitutional question, but it accomplished the same thing through the customs service—that is, it prohibited the landing on the United States coast of mackerel caught during the interdicted period.

Entirely similar legislation was addressed to the sponge fishery by the fifty-ninth Congress. The recent advent on the Florida coast of more than a thousand Greeks engaged in taking sponges by means of diving apparatus—a method prohibited by the Florida statutes—aroused the native sponge fishermen to a high pitch of excitement, and resulted in bringing the question to the attention of Congress, inasmuch as the state found itself powerless to cope with the situation, as the Greek divers plied their trade in waters beyond control of the state and also beyond governmental jurisdiction—that is, beyond a marine league from the shore. After a number of hearings, at which the views of sponge hookers, the Greek divers, and the Bureau of Fisheries were presented, a compromise measure, framed on lines suggested by the bureau, was agreed upon and became a law on June 20, 1906. The principal features of this bill, which goes into effect May 1, 1907, are: (1) no sponges taken with diving apparatus in the Gulf of Mexico or Straits of Florida shall be landed, delivered, cured, or offered for sale at any port or place in the United States, with the exception that sponges so taken in water

*The Southern Spring Mackerel Fishery of the United States, by Hugh M. Smith. Bulletin U. S. Fish Commission, 1898, pp. 193-271.

more than 50 feet deep between October 1 and May 1 of each year are exempt from the provisions of the act; (2) no sponges from said waters having a smaller maximum diameter than four inches shall be landed, delivered, cured, or offered for sale at any port or place in the United States; (3) the Secretary of Commerce and Labor is directed to enforce the act, and is authorized to call on the vessels of the navy and revenue-cutter service to assist therein.

Two bills designed to prevent citizens of other countries from engaging in the fisheries of the United States were under consideration but only one was passed. It applies to the waters of Alaska, and is particularly aimed at Japanese fishermen who, for several years, have been visiting the Alaskan coast in their vessels and making large catches of salmon and other fish. The report of the House committee on territories stated that the proposed legislation was "not by reason of the existence in the United States of any feeling of hostility toward the Japanese people, but because of the proximity of Japan to Alaska the Japanese fishermen fish more in Alaskan waters than all other aliens combined," and the committee pointed out that Attu, the most western of the Alaskan islands, is 900 miles nearer to Tokyo than it is to San Francisco. The other measure, prohibiting aliens from gathering sponges within one marine league of the United States coasts, was directed against the Greeks who have recently gone to Florida in overwhelming numbers and engaged in the sponge fishery with diving apparatus. Unfortunately this fishery is not susceptible of regulation in this way, as the entire catch is made beyond the three-mile limit. The bill, if it becomes a law, will have the effect of preventing the Greeks from engaging in the sponge fishery among the Florida keys, and, taken in conjunction with the other restrictive sponge legislation, may aid in curtailing the ravages of our sponge grounds.

After a struggle extending over many years, public sentiment in Maryland secured the enactment by the last legislature of a general law sanctioning the rental of bottoms for purposes of oyster culture. The law establishes a shellfish commission, and invites the co-operation of the United States Coast Survey and Bureau of Fisheries with the state in determining and defining the natural oyster bars. In order to give full force to this

feature of the Maryland statute, Congress passed an act authorizing the desired co-operation of the two bureaus in question with the Maryland shellfish commission and appropriating $15,000 to cover the expenses of the government work in connection therewith. This state and federal legislation means a great deal to the oyster industry of Maryland and to the large number of people who are fortunate enough to come within the effective range of the Chesapeake oyster; and a very marked increase in the oyster crop of the state may be expected in a few years.

Undoubtedly the most important fishery legislation considered and enacted by the Congress in question was that pertaining to the fisheries of Alaska, which, being an unorganized territory, is entirely under the control of Congress. The new legislation is a recognition of new conditions, and is a response to a very general demand for adequate protection for the vast fishery interests of our arctic province, particularly the salmon. The new fishery code for Alaska was formulated after extended hearings before the House committee on territories, and is acceptable to those engaged in the fishing industry as well as to the government. The act, which became a law June 26, 1906, and is immediately effective, "designed to reenact and harmonize many provisions of existing laws relating to Alaskan fisheries; to enlarge and extend the scope of restrictive features on fishing, and to include such further provisions for protection and regulation as are deemed essential to preserve and perpetuate the fisheries and to increase the natural supply by artificial propagation."

The leading features of the law are a tax on the products canned, salted, or otherwise prepared; the exemption from all taxation of those persons who operate private salmon hatcheries and liberate fry at the rate of 1,000 for every 10 cases of salmon canned; the prohibition of any trap, barricade, dam, or other fixed obstruction in any waters at any point where the distance from shore to shore is less than 500 feet wide, or within 500 yards of any salmon stream less than 500 feet wide at its mouth; the prohibition of any kind of net fishing which obstructs more than one-third the width of any stream, creek, estuary or lagoon; the prohibition of the laying of any seine or other net within 100 yards of any other net, and of the setting of any trap or other fixed appliance within 600 yards laterally or 100 yards endwise

of any other similar apparatus; the prescribing of a weekly close season for allkinds of net fishing; the authorizing of the Secretary of Commerce and Labor to restrict or altogether prohibit fishing in waters where there is evidence of over fishing, and to set aside any waters as preserves which he may deem desirable; and the prohibition of the canning or salting of salmon dead more than forty-eight hours; and the misbranding of any canned, salted, or otherwise preserved fish. From the foregoing it will be seen that a very comprehensive and satisfactory law has been enacted, and much benefit to the fisheries should be the immediate result. The tax on preserved fish, amounting to about $100,000 annually, was in the bill, as passed by the House, devoted to fish cultural work in Alaska; but this feature was not approved by the Senate and was not insisted on by the House.

The ravages of dogfish on the Atlantic coast, and the apparent willingness or inability of the states to cope with the problem of combating these destructive fish, led to the flooding of Congress with petitions praying for government aid. The plans and hopes of the petitioners were expressed in a bill introduced by a Massachusetts member of the House which provided for a bounty on dogfish to be paid out of the treasury of the United States, the bounty being 2 cents for each dogfish tail delivered to the proper officials of the United States government. The bill applied to the section between Cape Hatteras, N. C., and Eastport, Me., and had for its sole object the extermination of the dogfish.

In a hearing before the House committee, the very serious damage being wrought by these sharks was fully set forth by the author of the bill, by representatives of the fishermen, and especially by the chairman of the Massachusetts fish commission who had made a very thorough investigation and report of the matter. A representative of the Bureau of Fisheries, while conceding all that had been claimed in regard to the destructiveness of the dogfish, expressed doubt as to the efficacy of the proposed bill in materially reducing their abundance, and called attention to the far-reaching precedent that would be established if Congress should begin to pay bounties for noxious animals. The contention of the Bureau was for government assistance, but this should be in the direction of "determining the most effective methods of reducing the numbers of dogfish and of capturing

them in wholesale quantities; in demonstrating the economic value of dogfish as a source of fertilizer, oil, and leather, and the the most suitable methods of utilizing them for such purposes; and in testing the usefulness of the dogfish as food when used fresh or prepared by salting, smoking, and canning, and in developing the domestic and foreign markets for such preparations." The views of the Bureau were embodied in a bill, but Congress adjourned without taking any further action.

The most important measure recommended by committee which failed of passage was the so-called "omnibus fish hatchery bill." For a number of years no new fish-cultural stations had been authorized, except those provided for Alaska by the fifty-eighth Congress; and a large number of hatchery bills had accumulated in both Senate and House, and some of these had from time to time passed the Senate. In March, 1906, the House committee on the merchant marine and fisheries made a favorable report on a bill directing the establishment of twenty-three new hatcheries in as many states, and one combination biological station and hatchery on the coast of Florida. The bill carried an appropriation of $637,000, and would undoubtedly have passed by a large majority if it could have been taken from the calendar. It is generally believed that at the next session the measure will become a law.

FISH DISTRIBUTED BY PENNSYLVANIA FROM JANUARY 1, 1906, TO JULY 1, 1906.

BY W. E. MEEHAN, COMMISSIONER OF FISHERIES, PENN.

Miscellaneous fish	1,296	
Black bass	6,000	
Frogs	144,000	
Muscallonge	155,000	
Rainbow trout fingerlings	169,750	
Shad	1,013,000	
Smelts	5,000,000	
Lake trout fry	6,630,000	
Brook trout fingerlings	10,388,500	
Whitefish fry	36,764,000	
Lake herring fry	39,120,000	
Pike perch fry	50,600,000	
Yellow perch fry	63,505,000	
Pickerel fry	179,150,000	
Total distribution		394,646,546
In hatcheries yet to be distributed:		
Black bass approximately	160,000	
Frogs approximately	100,000	
*Sunfish approximately	100,000	
Cat-fish	200,000	
Gold fish for schools	25,000	
Miscellaneous fish	100,000	
Grand total		395,331,546

*A large allotment of sunfish is at the Pennsylvania Department of Health to be used in the attempted extermination of malaria-breeding mosquitoes.

PROGRESS AND EXPERIMENTS IN FISH CULTURE IN THE BUREAU OF FISHERIES DURING THE FISCAL YEAR 1906.

BY JOHN W. TITCOMB.

Experiments in the use of a salt solution for picking eggs by the *O'Malley process were continued at the Baker Lake and Baird stations and at the Bureau's laboratory in Washington, with the following results:

Superintendent O'Malley of the Baker Lake station reports that the solution was not used in the blueback salmon work, as the loss on this species was too small to warrant it. It was quite generally used in picking eggs of the silver salmon at both Baker Lake and the Birdsview substation, and for removing dead eggs of the steelhead trout at Birdsview the solution was depended upon entirely. It was found that the solution was in the best working condition when the specific gravity scale registered 1.076 With this solution nearly all the bad eggs floated long enough to be removed and all, or nearly all, of the balance could be picked by returning them to fresh water and putting them through the solution on the following day. As a rule the second application was not necessary because only a few bad eggs remained and these were picked out by hand in a few minutes. At the Birdsview substation the loss on the eggs ran as high as ten per cent. and the use of the solution resulted in a great saving of labor.

At the Baird station the use of the solution in picking eggs of the chinook salmon did not prove satisfactory but at the Battle Creek substation, where there was an unusual loss of eggs due to muddy water, the solution was used with most satisfactory results. The account of Superintendent Lambson's experiments is given as follows:

"Unfortunately orders to experiment with the solution were not received until the eggs at Baird had been eyed and picked ready for shipment. In the experiment of December 29 a small

*Salt Solution as an Aid to Fish Culture, by Henry O'Malley. Transactions of the American Fisheries for 1905.

hydrometer was used for testing the specific gravity of the solution; in that of February 2, a specific gravity scale furnished by the Department was used.

"Experiment No. 1. A solution of 1 part salt to 9 parts water was placed in a tub, the hydrometer reading 44; 20,000 salmon eggs, good and bad, were placed in the solution, and at the end of two minutes about 66 per cent of the bad eggs floated at the top and were removed with a scaff net, 34 per cent sinking to the bottom with the good eggs. A few good eggs floated at the top with the bad eggs. After remaining in the solution the eggs were removed to running water. They were then well washed and again placed in a solution reading 42 on the hydrometer and all of them, good and bad, promptly settled to the bottom. They were then returned to the trough. The eggs used in this experiment were from a lot that had been injured during the tender stage by an operator lifting the basket by mistake when packing for shipment. They were not picked at that time and when the salt solution was used the good eggs in the lot were well eyed while the dead eggs were just at the closing of the blastopore. The good eggs were not in the least injured by the salt solution.

Experiment No. 2. In this experiment the specific gravity scale was used and the eggs were all picked and counted before placing them in the solution. In a salt solution reading 1.076 on the S. G. scale 700 good eggs and 100 bad eggs were placed. Within three minutes 95 per cent. of the good and 5 per cent. of the bad eggs settled to the bottom. The bad eggs floating at the top were removed with the scaff net. The eggs were then returned to fresh water and well washed. After remaining in the fresh water for 30 minutes to remove all trace of the salt they were replaced in the solution, which had become diluted by the fresh water from the eggs and now registered 1.070 on the scale. In one minute all the good eggs and four of the bad ones settled to the bottom, while 96 bad eggs floated at the top and were removed by the net. The good eggs were all well eyed but the bad ones were unfertilized and had been held several weeks in pickle, though they were thoroughly freshened before being used. The good eggs were not injured by the salt solution and were packed

and shipped. The experiment could not be concluded owing to lack of eggs.

Experiment No. 3 was the best test of the solution since the experiments were started. It was carried on at Battle Creek Station where a large number of eggs had been killed by heavy storms carrying great quantities of mud into the hatchery during the very critical period. The acting foreman telephoned that it would be impossible to pick them by hand as in some cases the bad eggs greatly outnumbered the good, and extra pickers would have to be employed. It was impossible for the superintendent to go there at the time, and the acting foreman was directed to place the bad lots in a salt solution of 1 to 9 and if this did not work to strengthen or dilute the solution as required. The manner in which the experiment was conducted renders it worthless because the strength of the solutions is unknown but it is valuable in that it shows what may be done with large numbers of bad eggs. About 20 gallons of the solution, 1 of salt to 9 of water, was placed in a tub and 6,000 eggs in a basket were immersed in it. As soon as the eggs were placed in the solution they were at once agitated with the hand to break up any bunches among them. All the eggs floated and after remaining in the solution for three minutes they were returned to the basket. Fresh water was then added to the solution and the basket of 6,000 eggs was again placed in it. This time 75 per cent. of the bad eggs floated and were skimmed off, a few good eggs also floated but not enough to count. The good eggs went to the bottom in one minute. A little salt was added from time to time to keep up the strength of the solution as it became diluted by fresh water carried from the troughs by the eggs in the basket. Eggs were thus treated to the number of 2,267,500. As there were about 45,000 eggs to each basket it was necessary to divide them into seven or eight lots as good results could not be obtained with a larger number. In making the transfer from the trough basket to the dipping basket they were handled the same as in packing for shipment, that is, they were dipped from one and placed in the other with the regular hatchery dipper. After the eggs were removed from the salt solution they were emptied into another basket placed in the trough with running water, where the 25 per cent. bad eggs that failed to come to the top

were removed by the regular egg pickers. At no time could over 75 per cent. of the bad eggs be made to float. An examination of the bad eggs that persisted in sinking showed that they were eyed and had been killed by an influx of mud from a second storm occurring several days after the storm that killed the great majority. As the 25 per cent. were almost as old as the good eggs it would appear to prove that eggs killed at this time are of the same specific gravity as good eggs at the same stage of development, and therefore will not float in a solution in which good eggs sink. The acting foreman could not determine the exact strength of the salt solution as he had neither scales nor hydrometer. He estimated the amount in the first instance and then tempered it by adding water or salt until the best results were obtained. The eggs were not injured in the least by the brine and were later packed and shipped. This test comprised such a large number of eggs that it is considered conclusive. It seems to demonstrate that it is perfectly practicable to separate bad eggs from good ones provided the good eggs have reached the stage where they may be handled with safety and have developed beyond the stage of the dead eggs when killed. In other words there must be a difference in the development between the good and dead eggs to make a difference in the specific gravity, so that the heavier or good eggs may sink while the lighter or dead eggs float.

From the experiments made with this solution, conducted during portions of two seasons, the conclusion has been reached that for removing dead eggs normally occurring in the hatchery the process is not practicable at this station for the following reasons: It cannot be used until after the eggs have passed the tender stage, a period ranging from 12 to 20 days according to temperature. If they are not picked during this time the bad eggs will gather fungus and kill many good ones. The eggs collect in lumps and the salt solution has no effect upon them until they have been separated. As from 40,000 to 50,000 eggs are placed to a basket it would be necessary to handle them seven or eight times to get results, and as they are frequently shipped before they are eyed there is great danger of loss in so much handling. Then it is found that eggs of equal development will not separate in the solution and only such eggs that have died

some time before can be removed in this way. The eggs are picked during the tender stage as it is believed much stronger fish and smaller losses result than where they are covered until after they pass the tender stage, and if the salt solution were depended upon this could not be done. Even when the eggs are covered during the tender period it is customary to give them a very thorough picking during the first three days they are in the hatchery and where this is done there is no benefit to be gained from the salt as the death rate is very small; if the eggs are covered without this picking they must remain in the basket with all the dead and unfertile eggs for twelve to twenty days, which would certainly cause a very heavy loss. The solution is considered very valuable in removing dead eggs in special cases, such as noted in experiment No. 3 at Battle Creek. Here the eggs were all killed in a given period, and were in such numbers that it would not pay to pick them by hand. By the salt solution they were removed and the remaining good eggs saved. Accidents will happen at hatcheries, killing eggs in large numbers, and in such cases by waiting until the good eggs have grown old enough to handle, they may be readily separated from the bad ones with the salt solution.

To further test in ascertaining the value of this discovery laboratory tests were made by Mr. M. C. Marsh, scientific assistant, with eggs of four species of salmonoids. His results are reported as follows:

LAKE TROUT FROGS.

"Living eyed eggs float in a solution whose specific gravity is 1.076, and sink immediately in 1.058. The correct solution lies between 1.067 and 1.070. The latter is nearly always too strong. 1.068 effected an excellent separation with eggs killed by hydrochloric acid the previous day. Such eggs are uniform, all have the same specific gravity, and all float for one minute or more in the above solution. Eggs which have died naturally on different days and lain in the troughs for different periods are not so uniform, and the separation is not so complete. Some will sink immediately in the above solution. With those tried 50 per cent. to 75 per cent. were separated. Eggs killed at one time by smothering are also uniform and may be separated almost completely.

EYED WHITEFISH EGGS.

"Whitefish eggs nearly ready to hatch have a much lower specific gravity than lake trout or brook trout eggs. At 1.034 nearly all float, while at 1.029 they sink immediately. The best separation occurs at about 1.029. Eggs smothered or acid killed on the previous day may be almost completely separated by the above solution, although such eggs do not turn completely white within 24 hours after death. Like the lake trout, miscellaneous dead eggs dying naturally but not the same day, in the jars, do not separate completely, but yet a large percentage may be removed.

RAINBOW TROUT EGGS.

"Living eyed rainbow trout eggs from Wytheville, Virginia, nearly ready to hatch float at 1.079 and sink immediately at 1.060. At 1.066 considerable separation occurs, but the most favorable strength is about 1.072. Acid killed eggs may be thoroughly separated, though not perfectly, by this strength.

"The eggs for these trials were killed by pouring a little dilute hydrochloric acid upon some eggs in water in a beaker. Great activity was immediately shown by the embryos, which soon ceased (within ½ minute), leaving the embryos faintly whitish so that the eggs were distinguishable immediately from good eggs. After washing away the acid and returning the eggs to the tray on the water flow, the embryo after about one hour became more conspicuously white, and the next day the whole egg had turned white.

"Some unfertilized rainbow trout eggs from Manchester, Iowa, accompanying a shipment of eyed rainbow eggs, were tried in various salt solutions with a view both of separating them from other eggs and of determining the effect of the salt solution after returning the eggs from it to water.

"No separation of the unfertilized eggs from living eyed eggs could be made, as they were found to float or sink at practically the same time. They can, however, be separated from dead eggs turned white in the same way that the fertilized eggs are separated.

"The unfertilized eggs failed to turn white after treatment with the salt solution and return to fresh water. Following Mr.

O'Malley's procedure, a 1 to 20 solution was made, which had a specific gravity of 1.039. The unfertilized eggs were immersed in this, allowed to remain for a half-minute, and then returned to fresh water. Even after remaining in water over night they had not turned white, and were not distinguishable from untreated eggs. Stronger salt solutions were tried, but even after 1.125 for 25 minutes they did not subsequently change their appearance.

"The most effective separation of white eggs from live eggs and from unfertilized eggs which had not turned white was in a solution of specific gravity 1.077, and not in 1.072 as with former lots.

BROOK TROUT EGGS.

"Living eyed eggs nearly ready to hatch float in 1.077 and sink in 1.072. Specific gravity 1.0725 separates acid killed eggs almost perfectly, nearly every dead egg rising and nearly every live egg sinking within the first minute. There was no opportunity to try eggs which had died in the trays.

REMARKS.

"These trials refer only to eyed eggs and unfertilized eggs of the same age. Green eggs have not been tried, but since it is claimed that salt solution has much separating power with unfertilized eggs (salmon) at an early stage of development" and with "very immature eggs", it may be conjectured that the same will hold true of trout eggs.

"Eyed eggs which have died simultaneously may be well separated by this method. Eggs which have died successively vary in specific gravity and can be separated less completely, but nevertheless considerably. Its application practically will depend mainly on the condition of the dead eggs in this respect, but is indicated as possible with each species named and probable with the brook, rainbow, and lake trouts.

"The salt solution should always be adjusted with a hydrometer (salinometer). Special salinometers may be made to order to some advantage, but the ordinary hydrometers on the market will answer. Salinometers made for sea water are inapplicable for any of these species save the white fish, since they

do not usually read above 1.030. The highest of the usual series of three may sometimes be used for whitefish. The trials were made by immersing the tray itself with the eggs upon it in the salt solution.

"Evidently the temperature of the salt solution need only be such as not to injure the eggs by the temperature change. The temperatures of the solution actually used was between 43° F. and 52° F., and the eggs were taken from tap water at about 42° F.

"In no case did any injury appear from the action of the salt solution.

"The densities given here as correct for a given species need not necessarily be rigidly adhered to. In practice at different stations a somewhat different density may be preferable on account of the variation in lots of eggs from different sources, and the specific gravity instruments or hydrometers used may not correspond exactly. In these trials the density was taken in a glass cylinder, and the hydrometer was read by reviewing the scale from below the surface and not by the water which creeps up the stem above the surface. If in practice it is more convenient to float the instrument directly in the tank or box of salt solution the observer can not take the reading in this way but may adopt any uniform method, remembering that this will introduce another slight variation from the densities given above.

"Lake, brook, or rainbow eggs, recently dead, in which the embryo but not the egg has turned white, do not separate well from the live eggs.

"From a lot of eyed lake trout eggs arriving at Central station January 16, and containing a number of dead eggs, about 70 per cent. of the dead eggs were separated January 16 by a 1.068 solution. A few live eggs were contained among the dead removed from the surface of the solution."

It will be observed that no laboratory tests were made to distinguish dead or unfertilized eggs at early stages of development. If this feature of Mr. O'Malley's discovery is practical with eggs of other species than those already tested—notably those of the brook trout and lake trout—it will facilitate the preparation of eggs for long distance transportation, or for shipments to for-

eign countries where it is especially desirable to ship living eggs only.

It may be of interest to note that eggs which have turned white after death will assume the normal color of living eggs if allowed to remain in the salt solution for two or three hours. They resume the white appearance gradually when again placed in water.

NOTES ON POND CULTURE.

It is impossible in this article to go into detail as to the many experiments which have been made during the past year at the various stations, but definite data is being gathered as to the number of brood fish which can best be handled in a pond of given area and depth.

Some interesting observations have been made by Superintendent Green of the Fish Lakes station in connection with the spawning habits of the yellow perch, which entered one of the large ponds from the river as fry last season. When the ponds were drawn off the fish were placed in a smaller pond and retained through the winter. On April 2, when the water temperature was 50 degrees it was noted that they were spawning. They invariably cast their eggs on the west side of the pond. Several pairs were transferred to another pond where the same peculiarity was repeated. In order to further test the matter the following series of experiments were tried. On April 6, 12 pairs of perch were placed in a tank in which tufts of grasses had previously been placed at each end. On April 7, 8, and 10 clusters of spawn were found at the west end only. On April 10 several pairs were placed in another tank and tufts of grass deposited at the east end only. In this experiment one cluster of spawn was discovered on April 11 on the west side. The conditions were not changed, however, for five days, during which time no eggs were cast. The grass was then transferred to the west end and the following morning, April 17, three clusters of eggs were found on the west side. Another interesting observation was that the eggs were invariably cast at about five o'clock in the morning. The night watchmen were instructed to make observations every hour from four p. m. to eight a. m., and during the intervening time the observations were continued by other as-

sistants during the entire spawning season. The investigations were assisted by bright moonlight nights so that the movements of the fish could be noted accurately. They invariably appeared along the west side of the pond about five o'clock in the morning just at break of day. The eggs being cast at daybreak, it is inferred that the fish selected the sides of the ponds and tanks which first received the sunlight. It is interesting to note that the fish were but one year old when reproduction commenced. Actual measurement of some of the smaller specimens showed the males to be 4½ inches in length and the females from 4¾ to 5 inches in length.

While collecting small-mouthed black bass fry from the spawning beds in a natural lake in Pennsylvania some nests were found containing eggs, very young fry, and fry ready to scatter. As the fish culturist in charge did not visit this lake until after many of the fish had finished spawning, no observations were made as to just how this happened. It would be interesting to learn whether more than one brood of fish worked on the same nest or whether one male invited several females to spawn at different periods on the same nest. The adult fish in this lake are very small and the average number of fry collected per nest was only about 250, the maximum number from one nest being 470. The lake where these operations were conducted is one of a group on the preserve of the Blooming Grove Hunting and Fishing Club in the town of Gleneyre, Pennsylvania. It is overstocked with small-mouthed black bass and evidently owing to lack of food the fish have become stunted. On June 5, several hundred nests containing eggs were examined on the south and west shores of the lake. Several days later these eggs had all disappeared. No fish hatched on these nests and there was no evidence showing that the eggs had died. The eggs were apparently devoured by the numerous bass. On nests where the eggs hatched or died a green moss soon appeared over the decaying eggs or shells but no such moss appeared over the several hundred nests on the south and west shores. Great difficulty was experienced in keeping the young fish alive more than twenty-four hours. They were taken from the nests soon after they began to rise from the beds. Unfortunately the bottom of the lake in the shallows is too rocky to permit of seining young

fish. It was found that when the young fish were left to roam about the shores for several days or weeks they were in much better condition for transportation.

EFFECTS OF LIGHT ON EGGS AND SAC FRY.

At the White Sulphur Springs station the water at times apparently contains noxious gases and at other times is superaerated. As a result the so-called "white speck" disease has occurred annually. In connection with the experiments in deaeration by the use of perforated pans observations in a general way showed that in some troughs of eggs and fish of the same lots there occurred losses of such marked variation as to attract especial attention. The fish culturist noticed that in the troughs of eyed eggs as well as young fish subject to a great amount of light the heaviest losses occurred. Control tests with eggs exposed to the sunlight after being eyed and eggs kept in a covered trough did not show much variation in mortality, the very slight difference being in favor of the covered trough. However, soon after the fish hatched there appeared a marked difference in the losses, the fish in the sun-exposed trough dying much faster than those in the covered one. The loss continued for some time but again became about normal or equal in daily loss to the covered trough. When the yolk sac was about absorbed and the fish were nearly ready to feed the cover on the darkened trough was removed, and in a few days thereafter the fish in this trough began dying rapidly, while the loss in the exposed trough remained about normal. All the fish that died developed the "white speck" disease. The fry in the troughs were carried to the fingerling stage and the percentage of loss in the covered trough amounted to 47.2 as against a loss of 64.8 for the unprotected trough, making a difference of 17.5 per cent. in favor of the darkened trough. Superintendent Robinson suggests that had the cover not been removed for a longer period the percentage of loss would doubtless have been only normal, as the fish in the darkened trough failed to develop the "white speck" disease until after being exposed to the sun, which indicates that sunlight as well as very strong light has a deleterious effect upon not only green and eyed eggs, but upon fish previous to the total absorption of the

sac. Further control experiments will be made in order to obtain more definite information on this subject.

SUPERAERATED WATER.

A suggestion comes from Fish Culturist G. W. N. Brown of the Erwin station that fry being carried in troughs supplied with superaerated water will thrive best if less than the normal supply flows through the trough. No control experiments have been made, but it is suggested that when opportunity is offered it would be a good idea to make control experiments along this line. He speaks of carrying from 30,000 to 50,000 trout fry from the period of hatching to four months old in troughs having a flow of water from three to seven gallons per minute. It was observed that when the flow of water was increased the death rate increased correspondingly.

COPPER SULPHATE AS APPLIED AT A TROUT HATCHERY.

At the White Sulphur Springs, West Virginia, station the water supply is from springs. For a distance of 200 feet from the intake the water is conducted underground in terra cotta pipes. It is then conveyed in an open ditch for about a 1,000 feet. This ditch at the water surface is about seven feet wide, and from 2 to 3 feet deep. It is tapped at a number of places for supplying the different ponds. Spirogyro grown very rapidly in this open ditch, clogs the screens at the various intakes, and is thus very objectionable. It has been found that the application of copper sulphate in a mixture of about 1 part to 4,000,000 applied about 8 hours each week, almost entirely eliminates the algae, with no injurious effects upon the fish. After the copper sulphate has been applied for the stated period the fish eat but little food, and if applied 16 hours will entirely refuse it. The lack of appetite lasts but about 12 hours after the application has been discontinued.

The flow of water through the ditch was only roughly measured, hence the proportions given above may not be correct. The experiment was conducted under the direction of the pathologist of the Bureau, M. C. Marsh. The copper solution was dissolved in a barrel, and was applied at the head of the ditch by

the use of a siphon. In order to have the same volume of the mixture flowing constantly a floating siphon was used, so that the same head was maintained while the mixture was being siphoned off. The first test made was with an application of 1 part to 3,000,000. A few trout in the ditch were killed by this solution, and some of those in the ponds supplied with water from the ditch gave signs of uneasiness. With a mixture of 1 part to 4,000,000 there has been no loss of fish. This does not prove that the solution can be constantly applied in flowing water in the proportions above given, and what proves to be a proper remedy in this particular instance might be fatal to fish if applied in some other water system under apparently similar conditions.

In considering the eradication of algae in water supplies to trout hatcheries and ponds, and especially in connection with intensive pond culture, it must be kept in mind that Nature's balance as to water aeration may be upset if the algae is removed.

*An instance is reported at Cold Spring Harbor, New York, where a spring at the edge of a reservoir pond shows a deficit in oxygen of 1.25, while in the middle of the pond there is an excess of 3.11 in oxygen due to the thick growth of algae, chiefly Spirogyra, which lines the bottom of the pond throughout its entire extent, but is heaviest at the middle.

GROWTH OF EGGS DURING THE PERIOD OF INCUBATION.

Observations made at various stations indicate that fish eggs of almost all species propagated increase in size from the time they are water-hardened up to the time they are about to hatch. The amount of increase is not large but will run from about one to three per cent., according to the species. This suggests that it is unsafe to use the same measure for green eggs and those fully developed, especially when large lots are being handled. In this connection attention is called to a new form of measuring gauge to ascertain the correct diameter of fish eggs, devised by H. von Bayer, architect and engineer of the Bureau of Fisheries, a sample of which is presented for your inspection at this time. A scale of this character is very useful in making tests as

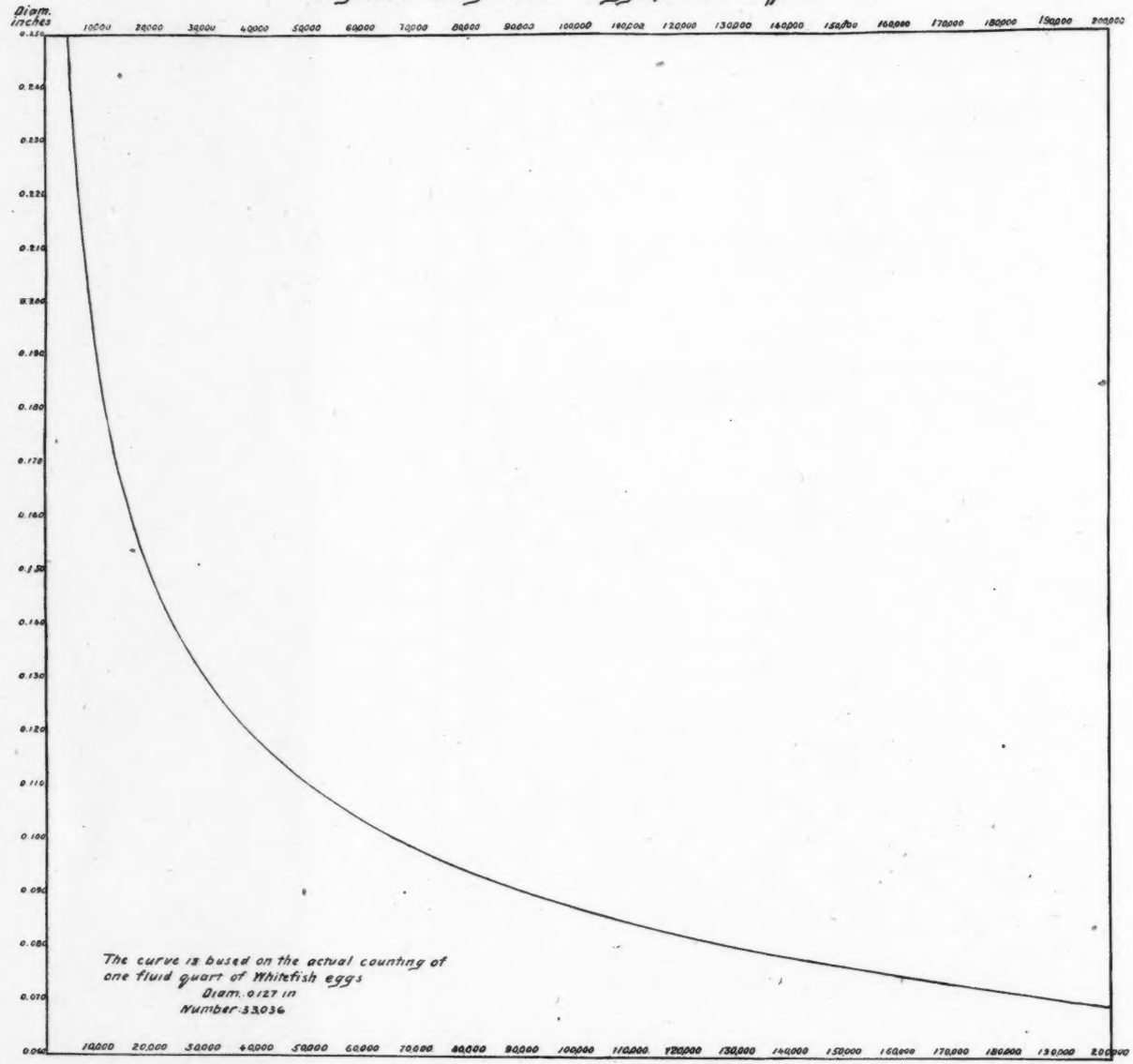
*M. C. Marsh: Tenth Annual Report of the New York Forest, Fish and Game Commission.

to the increase in the size of eggs during the period of incubation. In connection therewith Mr. von Bayer has prepared a diagram based upon which, after knowing the diameter of the egg, one can ascertain the number of eggs to the quart. This is especially useful in establishing the number of eggs to a quart where the actual number has not been ascertained by counting, as frequently happens in taking up the propagation of a new species. It is thought it will be especially useful in the propagation of fish the eggs of which have a small diameter.

SUMMARY OF DISTRIBUTION OF FISH AND EGGS DURING THE FISCAL YEAR 1906, BY THE BUREAU OF FISHERIES.

Species	Eggs	Fry	Fingerlings, Yearlings and Adults	Total
Catfish	.....	500	63,915	64,415
Shad	495,000	37,504,300	.....	37,999,300
Whitefish	73,099,000	263,400,800	.....	336,499,800
Bluefin whitefish	.....	1,140,000	.....	1,140,000
Lake herring	38,300,000	3,410,000	.....	41,710,000
Chinook salmon	115,628,645	21,789,928	122,980	137,541,553
Silver salmon	239,180	6,445,574	23,140	6,707,894
Blueback salmon	122,500	9,923,680	9,500	10,055,680
Humpback salmon	2,000	1,528,504	.....	1,530,504
Steelhead trout	113,000	2,038,879	178,056	2,329,935
Rainbow trout	401,400	366,415	1,427,535	2,195,350
Atlantic salmon	.....	1,897,607	78,717	1,977,324
Landlocked salmon	204,000	481,144	75,677	760,821
Blackspotted trout	810,000	6,988,918	1,100,336	8,899,254
Scotch sea trout	.....	.....	504	504
Loch Leven trout	.....	22,525	78,000	100,525
Lake trout	25,090,000	29,084,540	73,180	54,247,720
Brook trout	960,000	5,333,049	3,689,689	9,982,738
Golden trout	.....	218,000	.....	218,000
Grayling	592,000	415,000	.....	1,007,000
Pike	.....	.....	15,000	15,000
Crappie and strawberry bass	.....	.....	87,528	87,528
Warmouth bass	.....	.....	2,375	2,375
Rock bass	.....	.....	41,042	41,042
Small-mouth black bass	.....	155,150	39,499	194,649
Large-mouth black bass	.....	103,800	434,162	537,962
Bream or sunfish	.....	.....	90,085	90,085
Pike perch	136,100,000	232,055,000	.....	368,155,000
Yellow perch	.....	161,943,000	3,065	161,946,065
Striped bass	.....	2,351,000	.....	2,351,000
White perch	5,400,000	176,690,000	.....	182,090,000
Cod	.....	159,492,000	.....	159,492,000
Flatfish	.....	285,049,000	.....	285,049,000
Lobster	.....	117,787,000	.....	117,787,000
Total	397,556,725	1,527,615,313	7,634,935	1,932,807,023

Diagram Showing Number of Eggs per Fluid quart



EXPLANATION AND USE OF DIAGRAM.

"The diagram is constructed from a table computed by the well known principle that the contents of solids are to each other as the cubes of their sides, or in case of spheres as the cubes of their diameters. The diameter of the whitefish eggs was accurately determined by placing a row of eggs in a graduated trough-like measure 6 inches long, then counting the number of eggs and determining their mean diameter in decimals of an inch. A quart measure was then filled with eggs of this given diameter, accurately counted, and the result used as the base in the computation of said table.

FORMULA.

$$d^3 : {d_1}^3 :: n_1 : n$$

$$\therefore n_1 = \frac{n \times d^3}{{d_1}^3}$$

$d = 0.127''$	Diameter of whitefish egg.
$n = 33036$	Actual number of whitefish eggs per quart.
$d_1 =$	Any other determined diameter.
$n_1 =$	Number of eggs sought.

"To use the diagram for finding the number of eggs per quart, look for the line on the left margin corresponding to the given diameter and follow said line to the right until it intersects the curve; from this intersection proceed at right angles to the marginal line of figures and there read the required number of eggs per quart."

DISCUSSION.

Mr. Titcomb. (Introductory to paper.): The experiments reported last year have been continued. Many of them must be continued a series of years in order to get any definite data.

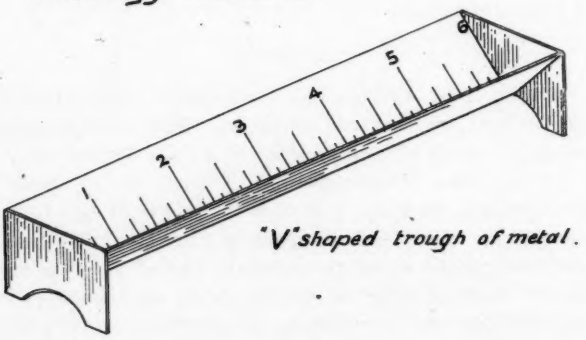
(At the close of the paper Mr. Titcomb said): Some observations were made this year as to the growth of eggs from the time they are water hardened until they are eyed. We tried almost every species which we propagate, and after trying several different kinds of scales for getting the actual diameters of the eggs, with the view of recording the growth, etc., the architect

of the Bureau devised this little scale or measuring trough. (Exhibiting scale.) It is just six inches long. You lay in just one line of eggs, and when it is just full you can easily get the diameter of each egg actually or the number of them to the inch. You can study the growth of trout eggs with it also. We tried ten selected lots and tried them when a day or two old, and again when eyed and we found a less number contained in the trough at the eye stage than when they were first water-hardened. It is interesting in several ways. Of course where you are measuring eggs in hundred million lots, like the whitefish and pike-perch eggs, if there is an increase in the size and you use the same measure in measuring eyed eggs, you are not measuring them accurately.

This really came up in connection with our trying to establish standard measures. I find there is a chance for improving our measure on some of the smaller eggs. When you get quarts of these fine eggs you can make a great deal of difference in total output by a very slight variation, and no two fish culturists will measure a quart of eggs alike. It is almost impossible for the same fish culturist to measure two quarts accurately. Now this diagram is not complete, because we could not get the whole scale onto this sheet.

But it is made on the basis of the actual count of whitefish eggs. We know the actual diameters of the eggs, which were counted by measuring several eggs in this little trough.

Fish Egg Measure.



Then we counted 33,036 eggs to the quart, with the diameter of the eggs .127. Now in order to get the number to the quart you come down to 127 on the scale and run down till you strike this curve, and here should be the actual number to the quart. Supposing you are propagating some new species like the rock fish and in a new field; it is a long and tedious task when busy with your work to find out what the aggregate number of eggs is to the quart. But you take the little trough and get your diameter and find that the diameter is .150 say. You run out here on the 150 line of the curve and it reads 20,000. This appears to me as very interesting and very original.

President: You have heard this most interesting summary of experiments of the bureau of fisheries. Do they suggest any remarks?

Mr. Meehan: The reference, by Mr. Titcomb, to the lake in Pennsylvania is interesting. The conditions in that lake are so extraordinary that a little more detail might be interesting. That lake is in Pike county, Pennsylvania and was formerly known as Knob pond, now Lake Laura. The lake was stocked with black bass in 1870, when about 40 fish were placed there. In 1873 that lake was literally alive with black bass of a large size. The lake is a genuine kettle hole lake, that is, a spring lake, on the side of a moraine. The greater part of its area is shallow, but there are depths ranging from 40 to 50 feet. It covers an area of about 400 acres. The bottom is covered with boulders left there by the ice. In 1873 the lake was literally alive with bait fish; there were yellow perch and roach or shiners and crayfish. Today there is not a living creature in that lake excepting the black bass, except there may be an odd sunfish or two, something of that sort. The fish are very small. To give you an idea how small they really are, four years ago five gentlemen undertook to fish and they put up a jackpot on the largest fish that was caught. The five men went out and caught 250 bass, and a nine inch bass took the jackpot. That will show more clearly than anything else how small these fish really are. I doubt if the average length exceeds 6 or 6½ inches. Bass six years old and four or five inches in length are rather curious. The lake is simply alive with them. I was there when

the Bureau of Fisheries men were there last spring, and can corroborate everything that has been stated. As to the number of nests there were far more than 200. The number of eggs on each nest was very small and I saw also at that time the three types, that is, the eggs, the fish that were newly hatched, and the fish rising all on the same nest.

I also saw three types in another lake on the same property, Lake Giles. There on one occasion I found eggs and fry, and in that particular case I saw two females on a nest, but I did not see the third female. It was believed at that time that the male had had all three females.

The difference between Lake Giles and the other lakes is that all the nests in Lake Giles were in water from 6 to 8 feet deep, making it extremely difficult to get the fish out. Lake Laura is the most remarkable instance of over-protection with which I am acquainted in Pennsylvania or anywhere else. The club is a very close corporation and allows no public fishing there. The lake is about seven or nine miles from the club house and over one of the roughest roads that a human being ever traveled. It is much easier to walk it than to ride, and the consequence is that comparatively few people go there, and not more than 6,000 or 8,000 fish are taken out of that lake in a year. The consequence is that the fish have multiplied far beyond the number that there should be in that lake and that is undoubtedly the cause of the stunted growth of the fish. The bass, you know, have an inordinate appetite and they have destroyed every living thing in that lake.

Mr. Clark: I would like to ask Mr. Titcomb a question in regard to this chart. Taking the basis of .0127, as the diameter in the case of whitefish, it shows 33,000 to the quart. Now on that same basis would it work out on other fish?

Mr. Titcomb: Yes, if you have the right diameter and get the proper number to the quart.

Mr. Clark: I do not think it would work out with pike-perch. As we measure them now, there are 150,000 pike-perch to the quart, but the number would be considerably lessened according to the new plan advocated. The eggs ought to go

about twenty-two to the inch in your little trough here and it does not seem to me that it works out quite correctly.

Mr. Titcomb: In the first place, I think Mr. Clark's measure is too liberal and in the second place, when he says 22 to the inch and you are considering millions of eggs by this chart you must get your diameter down very fine; the diameters given in our manual, when you come to figure them for this purpose, are entirely too inaccurate. The manual says 1-7 or 1-16 of an inch, etc., and the table ought to be revised. You will find when you get your base right and get an accurate diameter of any particular species and the actual number of eggs to the quart of that particular species, from it you can make your curve. I would not say that this curve is safe for a future basis now, but it will be made so. We are trying to get other counts and diameters as accurately as we did that, before we make this a conclusive thing; but the mathematics of it is correct and I think you will find it is going to work out and be useful.

Mr. Clark: That is what I am trying to get at. It is not conclusive yet. What I based the twenty-two to the inch on, the way I measured them, is an inch between knife blades.

Mr. Titcomb: Take the measure accurately by machinery and you get it a little more closely.

Dr. Bean: This subject is one of very great practical interest, and I trust that the mathematics of the curve by which the number of eggs is worked out will be, and I suppose has been, based upon a large number of counts of individual eggs, because every one knows that eggs of any species have an individual as well as a geographic variation. For example, Mr. Clark finds 150,000 pike-perch eggs to the quart; at Constantia they have 130,000. This is perhaps due to the fact that the spawning fish from Oneida Lake run rather smaller on the average than the spawning fish from which the United States Bureau obtains its eggs. But I wish to emphasize the necessity of containing the counts of eggs so as to eliminate individual and geographic variations; and then the scale, it seems to me, would be a great boon to our practical workers.

Mr. Titcomb: There is where the value of this scale comes in. When we once get the scale established we can take the pike-perch eggs at Dr. Bean's Lake and find they measure a certain diameter; take the eggs at Northville and find they measure another diameter; and we start a field station at Saginaw Bay and we find still another diameter. Now we can in a very few minutes, establish a diameter by taking a number of series of eggs from the various lots and thus determine the number of eggs to the quart in each instance and the very variation of the diameter of eggs of the same species is one of the features that makes this plan of measurement important. If we could say that pike-perch eggs run so many to the quart all over the country, we could get that established by counts from a dozen hatcheries and that would be the end of it; and here we go out to a new field and get the number of eggs to the quart from that chart in five minutes. You simply measure the number of eggs to the inch by means of the trough and the chart does the rest.

President: So that the use of this little chart scale is the essential thing after all.

Mr. Titcomb: It is very important.

Prof. Reighard: I was interested in what was said in regard to separating the dead eggs from the living; I would like to ask Mr. Titcomb whether the reason for the floating of the dead eggs in the salt solution has been made out? Is it due to the development of gas in the eggs through decay so that the dead ones float and the good ones sink?

Mr. Titcomb: I do not think it has been worked out to that extent. We assumed that the dead eggs immediately begin to decay and naturally the specific gravity becomes less than that of the live eggs.

Prof. Reighard: It occurs to me, that if that is the reason, possibly the method might be improved by waiting for that decay to proceed a little further. That is to say, if at a certain time you can separate 75 per cent of the dead eggs by means of a salt solution, by waiting a little longer time for the decay to take place, if it did not injure the living eggs, it would enable you to separate all dead eggs from living eggs.

Mr. Titcomb: We are able to do it in some cases now.

Prof. Reighard: If you wait till all the dead eggs have formed gases enough to float them, you might separate all of them at one time without having to pick over the eggs at all,—assuming, of course, that the formation of the gases in the dead eggs would not further injure the living eggs.

Mr. Titcomb: I do not know as I brought out one point developed in this experiment, that I intended to mention. You know you have many unfertilized eggs which retain the color of the live eggs for a long period, especially in cold weather, and if you want to pack the eggs when they are barely eyed, for a 40 or 50 day shipment, it is difficult to eliminate all those unfertilized eggs. If you put those unfertilized eggs in salt water and then back into fresh water, it causes them to turn white more quickly. That might be preferable to jarring the eggs, as they call it, giving them too much of an agitation to get the dead eggs out.

Mr. Lydell: I would like to ask Mr. Titcomb if the object of this chart is to establish bases for the measurement of eggs at different stations. All the eggs I received from the United States Fish Commission this year, which were measured, overran. Out of 100 quarts in one instance, I made the eggs measure 108 quarts, and I thought I was very careful in measuring them; but this chart, as I understand it, is to establish a basis for each station in different localities, inasmuch as the eggs are of different sizes in different localities, and not to establish a general law for measurements everywhere.

Mr. Titcomb: Yes sir.

President: Your statement as to the variation in measurement of the eggs you received, illustrates what Mr. Titcomb said, to the effect that no two men will measure the same eggs exactly alike, nor will the same man get the same results twice.

Mr. Lydell: I doubt whether the same man could measure 100 quarts of wall-eyed pike eggs twice alike.

Mr. Titcomb: My purpose in suggesting the use of the trough and chart scale is simply to have a standard for each sta-

tion, and not a general standard. I do not think it is safe to have a general standard, and the Bureau of Fisheries does not want any more eggs planted or distributed on paper than are actually put out; and that is so also of a good many states; I want to emphasize the fact that there are a good many states where they can make 300 or 400 per cent. of fingerling fish out of 100 per cent. of eggs, and we know that they have not had any eggs except those that have been sent to them; but this difficulty in measuring is another matter. We want to find a measure that will not vary. We have discussed different ways, we have discussed having a quart measure that tapers to a small diameter at the top, as the variation is, of course, very largely in the filling up at the top.

Mr. Nevin: The pike eggs we get at Lake Winnebago run 120,000 to the quart, while those we get at Tomahawk Lake run 80,000 to the quart.

Mr. F. R. Bassett: I would like to ask Mr. Titcomb regarding the separation of eggs by salt, if the floating eggs will remain floating during an indefinite time, or will they eventually sink?

Mr. Titcomb: I cannot answer that accurately. My impression is that they do not; that they sink.

Prof. Reighard: There is one other point in Mr. Titcomb's paper that interested me, viz: the finding of eggs and two different stages of fry in a single bass nest. It seems that this occurred in lakes where bass where very numerous, where there was overcrowding. Now, from what I know of the habits of bass and the other fish of that family, I take it that the male fish guarding the nest will continue to receive females, as long as there are females available, within certain time limits. It is simply a question of the number of females. As a practical point the condition referred to may perhaps be prevented by avoiding overcrowding. This might be a very serious matter, because very likely the old fish leaves the nest as soon as the first of the young are ready to leave and leaves the younger part of the brood to perish in the nest.

President: I would like to ask whether these old bass leaving the females indicates any human proclivities. (Laughter.)

Mr. Clark: We had an occurrence of that kind in a pond at Northville this year. The fry were nearly ready to rise when another female came and spawned on the same nest. Of course, it was necessary, in order to catch the fry that were rising, to put a screen over the nest, and the second lot of eggs died.

Mr. Titcomb: I want to ask Prof. Reighard if he thinks that the same male performed family duties for all three litters on one nest.

Prof. Reighard: I think that is very likely. I have known it to have taken place with the sunfish, and Mr. Lydell can tell you of one case where the same thing occurred with a bass.

Mr. Lydell: I have had several cases where the same male has taken care of two broods, and one where he has taken care of three broods, but not all at the same time. The fry after they arose were screened and taken away from him, then another female came on at once and we had a third lot of fry the same season. He was marked, everybody knew him and he would feed out of your hand. He had the whole pond to himself, and had an outlet to a big pond, and he actually reared three schools of fry in one season. The second was not as large as the first and the third was still smaller but in each instance we took the fry away from him. That applies to all males at Mill Creek. They receive the females as fast as they come. (Laughter.)

Mr. Titcomb: Last night Prof. Reighard spoke of the sunfish, when the second female appeared, cleaning off the nest which had the eggs on it. In the case of bass it is apparent that the male does not so readily oust the first family of young when he performs his duties with the second female. They clean off but once, I think.

Prof. Reighard: I do not know whether they ever clean the second time.

Mr. Bean: I wonder whether Mr. Titcomb or Mr. Meehan can give us any explanation of the unusual production of small mouth bass in these Pennsylvania lakes.

Mr. Meehan: It is only one lake.

Dr. Bean: Usually it is believed there is a good deal of cannibalism among these bass. Why don't the biggest bass eat the smaller ones, and thus reduce the number, as occurs in other places? If they have nothing else to feed upon, why do not they feed on one another?

Mr. Titcomb: They do feed on other food to some extent. There are shrimp there and other varieties of food under the rocks; there is quite a lot of insect life under small flat stones, but the race has become a stunted one, apparently for the lack of food.

I have knowledge of a lake in Vermont, formerly inhabited by several species of common fishes; the bullheads are one of them, and the yellow perch another. It was stocked with small-mouth bass which cleaned out every other kind of fish in this pond, and then became a stunted race, the maximum weight of the fish being about ¾ of a pound. Very likely it was so in Lake Laura. We used the fish in the Vermont lake to stock larger lakes for several years.

EXPERIMENTS IN FASTING OF FRY.

BY CHARLES G. ATKINS OF EAST ORLAND, ME.

It is my purpose in this paper to give further account of the experiments in the initial feeding of fry of which I told the Society last year.

The purpose of those experiments was to test the correctness of the opinion, generally held among fish culturists, that it is necessary to be very prompt in satisfying the first demands for food on the part of the fry of all kinds of salmon and trout, the penalty of neglect being the death or irreparable injury of the neglected fry, some writers on the subject having gone so far as to lay down the rule that there is no safety in the matter short of actual anticipation of such demands by offering food to fry a good deal before the absorption of the sack.

I was able to say at the time of the last meeting that, so far as could be seen up to the month of July, fry that had called for food in May or early in June and had been compelled to wait for five days had not appeared to suffer in consequence,—at least such treatment had not increased the death rate; that fasting for nine or ten days had not in all cases been followed by heavier losses; that in the case of the fry of silver salmon, of which four lots had fasted respectively for five, ten, fourteen and nineteen days, those that fasted the longest suffered the lightest mortality; and that the majority in the four lots of silver salmon taken together, from the beginning of the fasting down to fifteen days after its close with each lot, averaged little more than half as heavy as that of the kindred fry that were promptly and constantly fed.

In the discussion that followed the reading of that paper it was suggested by Mr. Talbot that though these fishes survived the ordeal of the fast they might have been so stunted by it that they would never reach the size that they would otherwise attain; and I was compelled to acknowledge that there was good ground for fearing that such would be the effect. I have now evidence in this matter which I am glad to lay before you.

All of the survivors of the starvation treatment in 1905 were kept through the season until October, each lot by itself, and fed and otherwise treated as nearly as possible in a uniform manner, except as to space, an exception that I shall refer to again. These experiments were tried in wooden troughs, all 12¾ inches wide, and with a water depth of 4 or 5 inches.

First let us look at the experience with Atlantic salmon. There were two series of experiments with this species, each series embracing four lots. The lots of the first series numbered at the start each 1,000 advanced fry, and each lot was maintained in a trough ten feet long. The lots of the second series numbered 500 each, of the same age and origin, and they were kept in troughs five feet long. In each series the fasts were for 5, 10, 15 and 20 days respectively. It was found, as stated in the former paper, that for a period beginning with the commencement of the fast and extending to 15 days after its close in each case, Atlantic salmon that had fasted for 5 days suffered a lighter mortality than those of the same origin that were fed promptly; that those fasting 10 days suffered a lighter mortality in one case and a heavier in the other; but that the fasts of 15 and 20 days were followed by a greatly increased mortality in both series. This indicated that 10 days was perhaps longer than such fry could be safely compelled to fast under the given circumstances.

For the purpose of comparing the death statistics of these fishes through the rest of the season I have arranged a statement in which the number of fish left at the beginning of each month is made the basis of the percentage for that month. On this basis it is found that the losses in both series of Atlantic salmon were much heavier in the cases of the most extended fasts; for August the losses were exceedingly light,—but a trifle heaviest among those that had fasted 15 and 20 days; for September the difference, though almost extinguished, still holds against the 20-day fasters of the second series, while in the first series the heaviest losses followed the 10-day fasts, next coming the 20-day and 5-day fasts successively, and the loss following the 15-day fast being the lightest of all. These September losses were, however, exceedingly small, the heaviest being less than one per cent.

On the 17th of October, all these Atlantic salmon were

weighed, and it was found that the heaviest fish were those that had the shortest fasts, they were averaging 35 and 37 grains respectively; but the smallest fish were not much smaller, 28 grains for the 15-day fast of the first series and 29 grains for the 20-day fasts of both series. Now comparing these with a control lot consisting of 2,986 fish that had been fed promptly and continuously, we find that the latter had not attained any greater size than the smallest of the first series of fasters and only a single grain larger than the smallest of the second series, and that out of the 8 lots of fasters there were 5 lots that actually outstripped in growth the full-fed fish.

Turning now to the brook trout, we find that in August and September the losses were very much heavier than with the Atlantic salmon, but the distribution of the losses was such as to forbid any decided conclusions favorable or unfavorable to the fasts. October 16th they were all weighed, with the very interesting result that the larger fish were among those that had fasted the longest, the average being, from the short fasts upward, 99 grains, 102 grains, 109 grains and 127 grains, successively, and the last named, which had fasted 19 days, had attained an average weight 14 grains (over 10 per cent.) greater than that of a lot of 3,595 trout that had not fasted at all.

The lake trout suffered so lightly during the late summer and autumn as to hardly afford any data except of a negative character (indicating that the fasting had done no harm) and in October the weighing showed that the two lots of greatest mean weight were those that had fasted the longest.

The mortality among the silver salmon was too light between June and October to afford data for comparisons, and the October weighing afforded data for only the negative conclusions that, when compared with each other, the long fasts had been little if any more detrimental than the brief ones; but when compared with a control lot of 2,441 salmon of the same species and age, it is found that these early and full-fed fish were decidely heavier than any of the fasters.

I must call your attention to certain points in which we are liable to err in our interpretation of the results above stated. Let us, in illustration, take up again the observations made on the brook trout. It was observed that the survivors of the brook

trout that fasted 19 days had attained, on October 16, a mean weight of 14 grains (or 10 per cent.) heavier than the fish of the same species and same original lot that had been fed promptly and abundantly, and that each move in the lengthening of the fast had been followed by an increase in size. Now without consideration of any other circumstances than those I have named, the conclusion is at once suggested that the fasting was the cause of the increased growth. But let us beware of jumping at conclusions. Let us see what other circumstances there were which may have had a bearing on the case. The different lots of trout in the experiment came originally from the same lot of eggs, so it is not likely that there could have been any congenital difference in capacity for growth. They were reared in water of the same origin and the same character in temperature and other respects. They received after the fast the same food, administered in the same way and, it was supposed, in the same quantity. But in one respect there was an important difference in the conditions to which the different lots were subjected: it was the matter of space. The lots of fasting trout were kept in troughs uniformly 5 feet long, while the main lots, the control lot among them, were in troughs 10 feet long. The survivors of the 19-day fasters, only 175 in number at the beginning of October, had about 5 square feet of space or 1 square foot for 35 fish. The other fasters had much less space, there being more fish to the square foot, and the control lot had, during the last part of the season, only one square foot of space for 107 fish, and earlier were still more crowded. Here, then, is an important advantage enjoyed by the subjects of the 19-day fast: they had three or four times as much room as the normally treated fish with which they were compared, and far more room than any of the trout that fasted for shorter periods; and this may account for their extraordinary gain in size.

There is one other point worth considering in this connection. It would seem almost inevitable that in the severe ordeal of the fasting experiments the fish that would soonest succumb would be the weaklings, and those that would survive the severest tests would be those of greatest innate powers of endurance and recuperation. This may have been another factor of importance in bringing about the remarkable results laid before you. And,

though it is going a little outside of the purpose of this paper, I venture to suggest that until investigation shall determine the matter, it be regarded as an open question, whether the starvation process may not be advantageously applied in a practical way to the weeding out of weak fish from our broods.

To sum up conclusions, I think the data here laid before you warrant us in concluding that fasting, carried to the extent of incipient starvation, though it may greatly retard the growth of fry and fingerlings in their early stages and produce actual emaciation, does not permanently stunt them but leaves with them the capacity of attaining normal size by rapid strides when placed under favorable conditions.

FASTING EXPERIMENTS 1905.

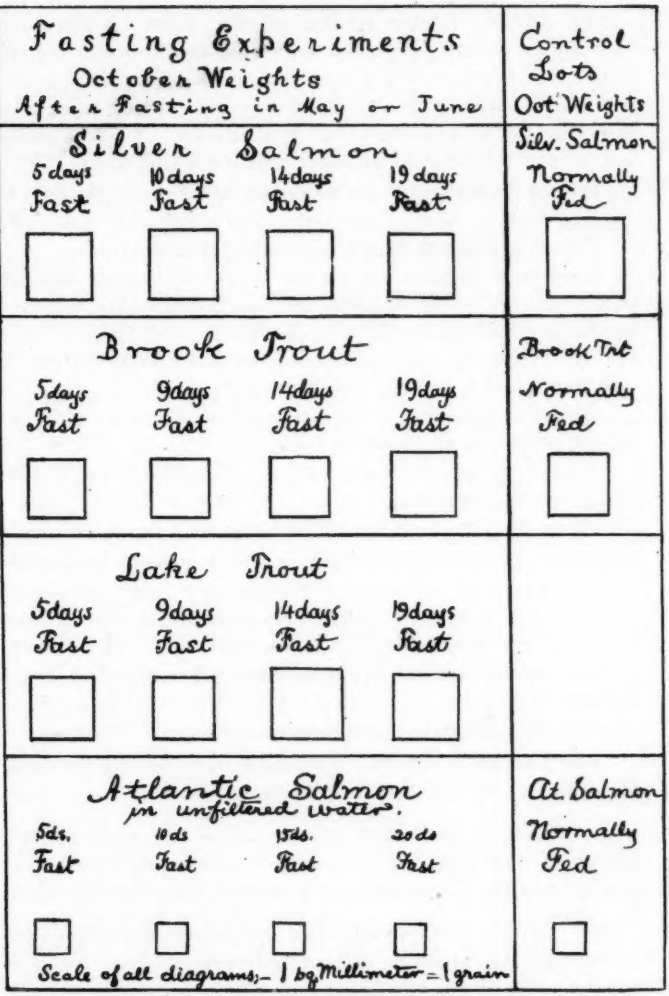
Lot No.	Kind	No. at Start	Length of Fast	Dates of Experiment
1832 A[1]	Silver Salmon	500	5 days	May 18 to 22
1832 A[2]	Silver Salmon	500	10 days	May 18 to 27
1832 A[3]	Silver Salmon	500	14 days	May 18 to 31
1832 A[4]	Silver Salmon	500	19 days	May 18 to June 5
1768 A	Brook Trout	1,000	5 days	May 23 to 27
1768 B	Brook Trout	1,000	9 days	May 23 to 31
1768 C	Brook Trout	1,000	14 days	May 23 to June 5
1768 D	Brook Trout	1,000	19 days	May 23 - June 10
1747 A	Lake Trout	100	5 ds. after 6 ds. feeding	May 23 to 27
1747 B	Lake Trout	100	9 ds. after 6 ds. feeding	May 23 to 31
1747 C	Lake Trout	100	14 ds. after 6 ds. feeding	May 23 to June 5
1747 D	Lake Trout	100	19 ds. after 6 ds. feeding	May 23 - June 10
1847 A	Atlantic Salmon	1,000	5 ds., unfiltered water	June 4 to 8
1847 B	Atlantic Salmon	1,000	10 ds., unfiltered water	June 4 to 13
1847 C	Atlantic Salmon	1,000	15 ds., unfiltered water	June 4 to 18
1847 D	Atlantic Salmon	1,000	20 ds., unfiltered water	June 4 to 23
1847 E	Atlantic Salmon	500	5 ds., filtered water	June 4 to 8
1847 F	Atlantic Salmon	500	10 ds., filtered water	June 4 to 13
1847 G	Atlantic Salmon	500	15 ds., filtered water	June 4 to 18
1847 H	Atlantic Salmon	500	20 ds., filtered water	June 4 to 23
1768	Brook Trout	19,174		
1832 C	Silver Salmon	2,500		
1847	Atlantic Salmon	.....		

FASTING EXPERIMENTS—Continued.

Lot No.	LOSSES AND PERCENTAGE BASED ON NUMBER OF FISH AT FIRST OF EACH MONTH.									
	May		June		July		August		September	
	Loss	Perc't.	Loss	Perc't.	Loss	Perc't.	Loss	Perc't.	Loss	Perc't.
1832 A[1]	6	1.2	3	.61	0	.....	0	.....	0	.....
1832 A[2]	5	1.	5	1.01	2	.40	0	.....	0	.....
1832 A[3]	7	1.4	1	.20	0	.....	0	.....	0	.....
1832 A[4]	5	1.	1	.20	0	.....	2	.40	0	.....
1768 A	4	.4	33	3.31	17	1.77	21	2.22	23	2.49
1768 B	9	.9	58	5.85	21	2.25	25	2.74	5	.56
1768 C	1	.1	531	53.16	13	2.78	15	3.30	2	4.55
1768 D	6	.6	773	77.77	6	2.72	4	1.86	1	4.74
1747 A	2	2.	3	3.06	2	2.11	0	.....	0	.....
1747 B	2	2.	15	1.53	1	1.20	0	.....	0	.....
1747 C	0	.....	44	44.00	4	7.14	0	.....	0	.....
1747 D	2	2.	70	71.43	0	.....	1	3.57	0	.....
1847 A	.....	.....	33	3.30	7	.72	7	.73	5	.52
1847 B	.....	.....	44	4.40	19	1.99	6	.64	6	.65
1847 C	.....	.....	39	3.90	58	6.04	10	1.10	3	.34
1847 D	.....	.....	159	15.90	109	12.96	6	.82	4	.54
1847 E	.....	.....	7	1.40	6	1.22	0	.....	1	.21
1847 F	.....	.....	5	1.00	8	1.62	1	.21	1	.21
1847 G	.....	.....	17	3.40	28	5.80	0	.....	1	.21
1847 H	.....	.....	40	8.00	62	13.48	3	.76	1	.25
1768										
1832 C										
1847										

FASTING EXPERIMENTS—Concluded.

Lot No.	Quarters	Weight of Survivors in October			
		Date of Weighing	No. Weighed	Total Weight	Av. Wght
	5 ft. trough			lbs. oz.	grs.
1832 A[1]	August 9—10 ft. trough	Oct. 17	428	8-0	131
1832 A[2]	"	Oct. 17	477	9-12	143
1832 A[3]	"	Oct. 17	486	8-14	128
1832 A[4]	"	Oct. 17	483	9-4	134
1768 A	10 ft. trough	Oct. 16	867	12-5	99
1768 B	"	Oct. 16	808	11-12	102
1768 C	"	Oct. 16	369	5-12	109
1768 D	"	Oct. 16	175	3-3	127
1747 A	5 ft. trough	Oct. 17	96	1-10	118
1747 B	"	Oct. 17	79	1-5	116
1747 C	"	Oct. 17	49	0-17	152
1747 D	"	Oct. 17	28	0-8	125
1847 A	10 ft. trough	Oct. 17	945	4-11	35
1847 B	"	Oct. 17	902	4-3	32
1847 C	"	Oct. 17	879	3-8	28
1847 D	"	Oct. 17	719	3-0	29
1847 E	5 ft. trough	Oct. 17	486	2-10	37
1847 F	"	Oct. 17	479	2-2	31
1847 G	"	Oct. 17	449	2-2	33
1847 H	"	Oct. 17	392	1-10	29
1768	7 to 13 troughs	Oct. 16	3,595	58-0	113
1832 C	2 troughs	Oct. 17	2,441	45-11	187
1847	4 to 8 troughs	Oct. 18	2,986	12-4	29


Fasting Experiments
October Weights
After Fasting in May or June
Control Lots
Oct Weights
Silver Salmon
5 days Fast
10 days Fast
14 days Fast
19 days Fast
Silv. Salmon Normally Fed
Brook Trout
5 days Fast
9 days Fast
14 days Fast
19 days Fast
Brook Trt Normally Fed
Lake Trout
5 days Fast
9 days Fast
14 days Fast
19 days Fast
Atlantic Salmon
in unfiltered water.
5 ds. Fast
10 ds Fast
15 ds. Fast
20 ds Fast
At. Salmon Normally Fed
Scale of all diagrams:- 1 sq. Millimeter = 1 grain

DISCUSSION.

Mr. Atkins: (Before reading paper.) When I began these experiments in 1905 I did not expect the results which I have found, and I hope you will bear in mind that I tried to be impartial and have everything accurately done, and have tried to be fair, tried not to warp the evidence in any way. I read a paper last year on the subject and now I have something to add.

During the reading of the paper Mr. Atkins made the following comments.

(Showing diagram of size of Atlantic salmon.)

It made no difference in the size of fish in October whether they fasted five or twenty days. So that the early and continuous feeding had apparently done the fish no good. I would not say that it had not done it any good but so far as the weight in October showed it had not done any good.

(Showing diagrams of Atlantic salmon of various sizes resulting from various periods of fasting.)

The control lot of silver salmon was considerably larger than any of the diagrams show.

(Exhibiting diagrams of lake trout.)

These lake trout were fed for six days before the fasting began and then they were made to fast five days, nine days, fourteen days and nineteen days, and the result was that in October the survivors did not differ a great deal in weight. This is average size, and the heaviest was in the case of those that had fasted fourteen days.

(Showing diagram of brook trout.)

Now, here are brook trout in the same way, showing five days, fourteen days and nineteen days fasting.

Dr. Bean: I would like to ask whether or not the starved fish which were submitted to a test of nineteen days, took food readily after the starvation period, when it was offered to them.

Mr. Atkins: Yes, in every case, just as soon as the fish were offered food they appeared to be entirely ready to take it, and in a few days, in every case, they appeared to be picking up.

Dr. Bean: Then these experiments would lead the way to very important practical results, namely, the weeding out of

starvelings or weak fish, and the advantage accruing in long distance transportation of fry.

Mr. Atkins: Yes, sir.

Mr. Clark: I agree with the doctor that it is very important, and I would like to ask Mr. Atkins about those lots of lake trout that were fed six days after they were taken from the tray.

Mr. Atkins: They were fed when they appeared to be ready. We were trying them from day to day and as soon as we found any fish that would take the food, then these fish were fed.

Mr. Clark: In other words, they were of such size that if you were going to distribute fry without feeding, they were ready to be distributed?

Mr. Atkins: Yes, sir.

Mr. Clark: That is the point. I have always advocated that fry should be distributed a few days before the sac was entirely gone. That is the point that I wanted to make. We need not be in a hurry about putting our fry out, and these I understand, were fed six days and then went through the period of starvation.

Mr. Atkins: Yes, sir.

Mr. Clark: In other words, the probabilities are that in the case of these fish that had been fasting nineteen days, and including six days of feeding, about twenty-five days would have elapsed after the absorption of the sac. Do you think that these fish would be in as good condition to plant as fry, as they would if they had been taken without any feeding? That is the point I want to get at.

Mr. Atkins: I hardly know how to answer that. You mean whether these fish after feeding and fasting would be in as good condition to transport and plant as though they had been taken in the very beginning?

Mr. Clark: Yes, sir. Your experiments showed that they were ready to take the food, did so, and grew rapidly.

Mr. Atkins: For instance, the experiments show, they are in

favor of the view, that they would stand transportation just as well then as before.

Mr. Clark: That is quite a point, I think for those who are distributing fry. There has always been such a hurry to get the fry out early, in order that they may find plenty of food either as soon as, or before the sac is entirely absorbed.

Mr. Titcomb: Is not there another point there? I want to ask two or three questions in connection with it. But the first important point is the fact that this fish will stand nineteen days fasting. We will say that you distribute them just as they are ready to take food: a great many people argue that they are very weak and get very little food. We will acknowledge that some of them fast after they are planted, more or less, after the first 19 days. But this brings out the conclusion that that fasting is not going to injure them, as it is a point in favor of fry planting.

I want to ask Mr. Atkins if he sees any advantage in feeding 6 days just before the sac is absorbed, before fasting, or would the other method be best, of having them begin the fast immediately?

Mr. Atkins: I see no advantage in this, but I had heard it said that it was better to avoid any feeding and then interrupting it.

Mr. Clark: That is right.

Mr. Atkins: So I thought I would try that series of lake trout in that way, feeding them a few days first and then making them fast, and they came out in very good shape—in such very good shape that in several thousand there were only two losses in August and two in September.

Mr. Titcomb: Another question: Between the control experiment and the other did you consider the volume of water supplied to each trough as a factor?

Mr. Atkins: Well, not carefully, no sir.

Mr. Titcomb: You gave, of course, a much larger flow to the control trough which had the larger number of fish in it, than to the others?

Mr. Atkins: I suppose that we did, but that matter was only looked at and no measurements were made that I can now recall.

You do not know the volume of water that flowed to each trough?

Mr. Atkins: I cannot state it now.

Q. Don't you think that that is an important feature to consider in a control experiment?

Mr. Atkins: Yes, I do.

Mr. Titcomb: I think these experiments are grand, and are bringing out some very valuable information. Some of you may not have read Mr. Atkin's paper of last year in which he brought out the point that it was not necessary to begin the feeding of the fry immediately after the sac was absorbed or before. Mr. Atkin's experiments demonstrate conclusively to me that there is no necessity of giving those fish any food until several days after they naturally would take it. I should conclude from the experiments that instead of giving food to sac fry in the later stages, as many do, it is a waste of food and not only a waste of food but it is apt to foul the water. You eliminate all that, and the conclusion is reached that it is as well not to feed the fish for several days after they are able to take food.

Mr. Atkins: These experiments indicate that there is no advantage in feeding while in the sac stage, and it would be simply a waste of food and a pollution of the water, and we have another series of experiments in the same line going on this summer and so far as we have gotten with them they are telling the same story as last year's experiments, and the last year's experiments told the same story as some I tried once or twice before, only less carefully; so I feel safe in saying that there is no particular hurry in feeding the fry; if they have to fast several days after they first wish for food, it will not be likely to do them any harm.

Mr. Titcomb: How many days would you suggest, in a general way, should elapse after the sac is absorbed before you begin to feed—from what experiments you have made?

Mr. Atkins: Well now, really, I have not gone so far as to consider that. In fact I have not yet introduced into actual practice any rule which would delay the feeding at all, but I have allowed the fish to be fed as soon as they wanted food, except the experimental lots. I think I ought to study that a little further and see if there would not be a positive advantage in withholding food for several days.

Dr. Birge: Would it not be possible to put screens into the troughs so that the control fish and the fish you are experimenting on, should have each the same amount of water surface?

Mr. Atkins: Wouldn't they have in the same trough?

Dr. Birge: Yes, and as the fish died could you not put in a wire screen, for instance, to cut these fish off from part of the trough, as they get fewer in number, so that you will have just so many fish to the square foot?

Mr. Atkins: Yes, I think that would be worth while, so that as the fish died off the space could be lessened; and then I would hardly expect the same results, because I think the great growth shown by these fish that fasted so long, was very likely owing in the main to having so much extra room.

Dr. Birge: That is true of invertebrates, that they will grow much more rapidly with more space.

Mr. Titcomb: I would suggest that in further experiments you consider the volume of water and make the control experiments exactly alike. Have the dimensions of the trough for each experiment the same, and the volume of water the same; and as you increase the volume with the growth, if you do, keep a record of that. And this suggests what Dr. Birge has said: One thing you want to bring out in connection with this experiment is, what is the actual number of trout of a certain age or size, or other fish, like the salmon, which can be carried in a foot of water to best advantage. That is a point which we ought to be able to publish in our fish cultural books as well as the other. That would come in with your experiments very nicely, I should think.

Mr. Atkins: Yes.

Mr. Clark: I wish that this discussion might continue the remainder of the day. I think here is one of the most important papers and subjects for the benefit of fish culture that has been brought out. I am very glad that Mr. Atkins did not make these experiments and bring this matter to notice twenty-five years or more ago, when they called me the father of the fingerling. He is certainly knocking my theory all to pieces, that it is so much better to plant fingerling fish. I have always advocated that the reason for planting fingerlings instead of fry, was because they were stronger and better able to take care of themselves. However, from the experiments made by Mr. Atkins, even starved fish are ready to take food, and I certainly think that this very important matter should be further investigated, and I trust that Mr. Atkins will continue along the same lines he has so successfully started.

Dr. Bean: I do not see any other paper on this programme in which the question of feeding fry is likely to come up. Therefore I hope you will allow me to make a few remarks about an experiment with brown trout this year. There is always a time in the life of a trout when it will refuse to take food. In fact the mortality among trout is largely due to the refusal of the fish to take the food offered to it, particularly where liver and allied foods are employed. There were cases of this kind this year in May and June at several stations in New York state, and the men in charge, old fish culturists, men of experience, tried in every way possible to induce the brown trout to feed, but without success, until they had arrived almost at the point of death from starvation. Liver was used and whatever other dead animal food of that sort was available, but without success. Then the fish doctor was called in, and naturally, as the species was brown trout, he suggested crustacean or molluscan food. Well, as the crustacean food at these stations was the more readily obtainable, the superintendent was asked to try a variety of shrimp, which was very plentiful, just to take the shrimp, crush them in a sieve, and make an emulsion corresponding with the liver emulsion. This was tried at two stations, and in less than 15 minutes all of the brown trout which had refused to take food were feeding merrily, and the situation was saved. I suppose this has been

done by other fish culturists, but I was anxious to relate it here, hoping it might help some other practical men to save their fish.

Mr. Meehan: Occasionally we have found where fry refuse to take food, that the addition of a little salt would sometimes have the effect of starting them to feed, that is, a mixture of a little salt with liver, not very much, just a little—we found that particularly in the case of some Atlantic salmon that would not feed until we put a little salt in their food, and then they took it with readiness. Whether that would work out all through or not I could not say, but in our hatcheries it did very well with the Atlantic salmon and in one or two cases with brook trout. We very seldom had much trouble with regard to the question of feeding, but occasionally they would not take food, and when they did refuse we found that the salt would help.

Dr. Bean: We tried that method also but without success. We tried another article of food which has been used by a good many members present, salted haddock roe, but that did not tempt them. Nothing but the food which they wanted, which happened to be shrimp, filled the bill.

Mr. Titcomb: The question of salt in the food has come up, which leads me to express the desire that the fish culturists who handle trout will make control experiments, feeding fresh liver and meat which has a trifle of salt in it. Some fish culturists who raise large quantities of Atlantic salmon, brook trout and land-locked salmon, use no salt. I think there is a good opportunity for control experiments there. This is merely a suggestion.

If this subject is exhausted I want to ask Dr. Bean to tell us something more about this brown trout work. We have given up the propagation of the brown trout. We consider that fish objectionable because it is not as good as the brook trout and when placed in the same stream with the brook trout we understand it is so cannibalistic that it eats the brook trout. It is a stronger and larger fish, and should not be planted in any brook trout waters, from our point of view.

Dr. Bean: I do not know just the particular point Mr. Titcomb wants to know about the brown trout work in New York State.

Mr. Titcomb: The extent of it.

Dr. Bean: The extent is much less than it was a few years ago, and the policy of the commissioner is in line with Mr. Titcomb's suggestion, that the brown trout should never be planted in any waters that have brook trout. Beaver Kill River illustrates the bad effects of this method. A friend of mine, a very expert angler, told me he got ten brown trout to one brook trout in the Beaver Kill; the cause of that is unquestionably (at least in the minds of the anglers, and it seems reasonable) that the brown trout destroy the brook trout. If they do not, they at any rate destroy the food of the brook trout, which amounts to the same thing. So that the work of New York now is very much reduced in volume, and there is a continual desire on the part of the commissioner to refuse applications and in fact he does postively refuse applications for brown trout to be planted in brook trout waters. They are suitable for some waters, undoubtedly, waters which contain no other trout, and have done very well there. But this year there is a very grave difficulty with the brown trout, which is no doubt familiar to most of you, and that is the ulcer disease which has broken out in some places, particularly in streams which are polluted with drainage from manure heaps; and it is so fatal that there is a very strong inclination to discontinue absolutely the use of such streams in the future for all race and pond work at stations, believing that unless the head waters can be controlled, so that the cause can be absolutely removed and the waters be disinfected by quicklime or in some other way, it is useless to attempt to remove that bacillus which causes the ulcer disease and destroys the brown trout.

Mr. Titcomb: Does it infect the other species?

Dr. Bean: None except the brook trout. The rainbow trout is immune thus far, but it is very fatal to the brown trout.

Mr. Whish: Once again the lay brother finds a chance to get back at the scientist. We have had in this society several confessions during past years which have evidently been good for the soul, and I have just chuckled over them.

It all comes, in my judgment, from trying to get something foreign in place of something which is native born, believing

that because a thing comes from Europe it is just a little better than anything that grows in America. I was not brought up in any such belief and I do not believe it now.

We had in bird life the English sparrow. I remember when I was a student in the high school, a prize was given to the scholar who would write the best essay on the beauties of the English sparrow which was then being introduced. I have been somewhat of a fisherman ever since I was a little farmer boy with ragged trousers and could get a pin and a piece of string; and I remember when eminent scientific gentlemen threw up their hands and cheered at the discovery of the great carp. I have sat in societies and heard gentlemen of eminence confess—I may say also, confess very carefully—that the introduction of the carp was a fish-cultural tragedy, and I am hearing the successors of these scientific gentlemen confessing very cautiously that the introduction of the noble brown trout is the same thing.

Now this is to me a matter of great glee. (Laughter.) I am a lay brother and I do not know any more science than I have read and I do not know much more science in the fish-cultural line than what I have been taught. But I was told a year or so ago, very cautiously, by a gentlemen of the United States Bureau, that they guessed they would not cultivate any more brown trout.

Now, why don't these scientific men know these things before it is too late?

Our birds have suffered from the introduction of the beautiful sparrow.

President: You don't want a man to know it all at once, do you?

Mr. Whish: It would have been for the best interests of the people at large if some of these things had been known beforehand. That is only my judgment. I hope these things are entertaining to the scientific men.

But here is your carp question: Would it not have been better if they had found out where these fish were suited to go before they put them into the waters of the country? And would not the same thing have been better with relation to the brown trout?

Of what worth is your scientific man if he cannot give proper

advice when great questions of this kind arise? For it is a great question to introduce into the waters of a state, or of a nation, a fish about whose habits you know nothing except as they occur on the other side of the ocean; and however, they may have been on the other side they certainly are different when they get here; and I think (as a lay brother having particular glee in getting back at the scientist again) that in the future, if somebody offers a species of fish that is great and good in another country, it would be the part of wisdom—to try it out in a secluded spot well fenced in, before giving it to the nation at large to the destruction of the better fishes. (Applause.)

Mr. Meehan: I fully agree with Mr. Whish in regard to keeping our indigenous fishes, but I cannot agree with him in laying the blame on the scientific man. From the experience I have had I rather think he has the wrong pig by the tail. My experience has been (and it has covered a great many years in fish-cultural work) that the real offender is the lay brother and not the scientific man.

Going back for a number of years to the carp, which is perhaps the beginning, the real responsibility for introducing that fish rests not so much with the man who introduced it and spoke of it in the first place, as with the people themselves. They heard about it, wanted it and demanded it, and they forced it in many cases against the advice of scientific men. The same thing to my certain knowledge is true in Pennsylvania, at any rate so far as the brown trout is concerned. The anglers demanded it; they said: "Here is a fine fish; we have heard a great deal about this fish, the Isaac Walton fish and the brown trout, and we want it in our streams;" and when the commissioners or those who were responsible refused to give it to them, they went to the members of the legislature, and the members of the legislature went to the commissioner and said: "No brown trout, no appropriation." (Laughter.) That is responsible for the introduction of the brown trout and the introduction of the carp in many places, at any rate, and it is the same thing today in regard to other fishes. I have people, "lay brothers," who have come to me and want lake trout and black spotted trout and black bass and calico bass and rock bass and every other kind of fish, planted in a single

body of water that is only big enough to hold one or two species of fish. I do not think I can lay that on the scientific brother. You have more trouble with the layman than with the scientific man, and that is particularly the trouble in regard to the planting of fish.

Going back to Mr. Atkins' work some years ago, some people began to agitate (and they were not the scientific people) the planting of trout, for instance, in the fall of the year instead of the spring of the year: "because," they said, "the fish have been taken care of in the hatcheries all the summer and they are fine, large size, and can take care of themselves a great deal better when planted in the fall of the year." That bit of poison got all through Pennsylvania, and is not yet out of the system; although our experience has shown that the planting of advanced fry produces best results; but men will say today that in streams where there is better fishing than there has been for twenty years, it would be better to have 250 trout in the fall of the year than 1,500 in the spring,—that is "the lay brother," not the scientific man.

Mr. Titcomb: I believe the subject of fry versus fingerlings is taboo in this society, but I want to agree with the last speaker on the demands of the angler. It is astonishing to see the number of kinds of fish that the man thinks he can get into a small pond. My question to Dr. Bean was put because a great many people today want the brown trout; the majority of them have never seen brown trout and only know it is different from what they have, and they do not want it necessarily because it comes from Europe but they want it just because it is different; the New England people call for rainbow trout, although we have not succeeded in introducing them, after putting millions of them there,—but they want something different. In Pennsylvania the people are learning gradually that the rainbow trout is not very valuable and they are coming back to the native trout. It is the same thing all over the country. They get in one or two kinds and want half a dozen.

Mr. Whish: I only wish to say that it has always seemed to me that the scientific man ought to be a sentinel on the outer works to give warning of the approach of the enemy; and he

ought to know the enemy when he sees him so that he can give this warning. Now in New York state, as Dr. Bean can very well advise you, we have this same trouble about the demand for fish for waters for which they are not suited, but Dr. Bean can also tell you that we do not give these fish any longer.

There was a time when, acting on the conduct, I might say, (not the advice, because I do not think it was asked) of the United States Bureau of Fisheries, carp and brown trout were ladled out very handsomely; but that time is past.

Mr. Titcomb: I want to answer that. (Laughter.)

The brown trout has not done very much damage in this country. We have made the experiment and have discontinued its propagation, except at one station where we are conducting some control experiments on just one wild stream in South Dakota.

So far as the carp is concerned it was first distributed by private enterprise, and later by the United States Fish Commission. While we acknowledge that it was not economical to give those fish to everybody who wanted them for waters in the north, the clear waters of New York and New England for instance, yet today if it were not for false notions prevailing regarding carp, we would be propagating and distributing them in large numbers. The people in the west where they have tanks and mud ponds and small reservoirs, which catch the surface water, beg for carp, and we know the carp will do better in some of those waters than any other species. A recent article written by Leon J. Cole on the carp of the Great Lakes, is well worth your reading, to show what carp is there, and its value; and if you look at statistics you will see that the carp is a very important fish, in the commercial fisheries of this country, especially in Illinois.

Mr. Clark: Has anybody yet, scientist or lay brother, ever given proof that the carp caused any harm? Show it to me if you can.

President: Inasmuch as that brings up a discussion that we have been engaged in for fifteen years, I will rule out the answer. (Laughter.)

Dr. Bean: De mortuis nil nisi bonum! The carp is dead,

long live the carp! The member from Albany answered his own question. He lays the blame for such things upon the scientist, but he forgets, perhaps, that the present administration of the New York Fish Commission is only about three years old, and he is whipping some very much older scientists over the shoulders of the able men who represent New York at present. You might just as well attempt to blame us Christians for not preventing the crucifixion; but we were not born soon enough.

President: It is like a great many cases of death in a great many parts of the country, the doctor was called in too late. We have got them today and they will do work no other fish can.

Mr. Lydell: We have got carp and whitefish and black bass in one pound in the Mill Creek station and they are all doing very well.

Mr. P. G. Zalsman of Paris, Mich.: Of course in respect to putting them in small streams: I deliver rainbow trout sometimes to a farmer and the fisherman says: "Where are those fish going?" "I don't know." "If I knew who was going to put them in such and such a stream I would kill him before he got there. We do not want the rainbow trout in these streams."

Mr. Meehan: There are certain places where they call the brown trout, California rainbow trout. I discovered that recently. People did not want the California trout in a certain county, and when I went there a few days ago a man showed me a fish which he called a "Californian" but it was a brown trout.

President: There is some prejudice against the rainbow trout in Michigan but I think it is uncalled for. It is a different fish, of course, from the brook trout but at the same time, as far as we can observe, it does no harm in the same stream as brook trout. Whether it will do any good or not is another question.

Mr. Meehan: We have found no trouble with rainbow trout as far as destroying other trout is concerned. But apparently they do not propagate very well in the stream.

Mr. Nevin: Rainbow trout do not do very well in small streams, but do well in the larger rivers.

GASES DISSOLVED IN THE WATERS OF WISCONSIN LAKES.

BY DR. E. A. BIRGE, OF THE WISCONSIN FISH COMMISSION.

Mr. President:

When I was listening to the remarks regarding scientists a few minutes ago I felt that the scientist in this meeting was somewhat in the condition of the carp. The sportsmen charge that fish with all sorts of crimes and casualties but when they bring him into court they cannot find him guilty of any of them. So the practical man tries to make the scientist responsible for all kinds of troubles, but when the charge is investigated it comes to nothing. If the scientists had not received so vigorous a defense it would be necessary perhaps for me to apologize for presenting a scientific paper to this meeting, but, under the circumstances, I will give you the paper without apology.

Some dozen years ago, or more, I began to study the life of the lower animals found in the open waters of the lakes of Wisconsin. I carried out one rather large job of that sort and found as I advanced in it that the conditions of life in lakes were not well known. So I then started to take up the study of the physical conditions of life in our lakes. Circumstances that I need not go into greatly increased my duties at the University of Wisconsin and for a considerable number of years made it impossible for me to continue those investigations. Only recently have I been able to take them up again, after long interruption, and to carry them on, although much more slowly than I could wish.

The subject that I am going to talk about today is the distribution of the oxygen gas in the waters of our lakes, and some thing of the effect of that distribution on the lake as a place for animal life.

I must begin with a few words in regard to the temperature conditions of lakes, because upon them the distribution of gas is founded.

Let Fig. 1 represent a section of a lake, and imagine the basin filled with water of uniform temperature, such a condition as

we should find in our lakes in October, November, or December, according to the depth and area of the lake. Now, if the wind

FIG. 1—Circulation caused by wind in lake of uniform temperature.

blows from one direction, for any considerable length of time, it will start a current of water moving in the direction of the wind towards the leeward side of the lake; when the water driven by the wind reaches this side of the lake it has to return; a comparatively small portion passes around the lake; more of it turns down on the shore, comes back at various depths along the bottom, or wherever it may find an opportunity. As a general result, if the lake has a uniform temperature from top to bottom, the mass of water, even though it may be 150 or 200 feet in depth, is set into rotation by the wind with comparative ease, so that the bottom water is brought to the top and vice versa, and a very thorough mixture of the water is made to all depths of the lake. Under these circumstances all the water of the lake is brought into contact with the air and becomes saturated with oxygen.

In the spring after the ice leaves the lakes, the conditions are substantially the same for a little while; the temperature is practically uniform, the water is set into rotation, kept in circulation and aerated by the action of the wind. But as the water warms, the conditions become different; and the warmer water

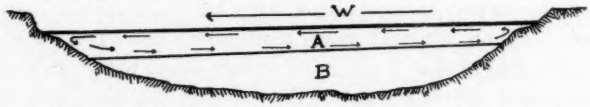


FIG. 2—Circulation in lake during summer. A.—Warm layer. B.—Cool water.

of the surface becoming lighter than the cooler water of the bottom, tends to float upon it. As the days grow longer, the influence of the sun becomes greater and as the nights become warmer, the cooling at night becomes less, with the result that the surface water gets very considerably heated. Under those circumstances when the wind blows the water across the lake, it

does not have energy enough to force the warmer, lighter water down to the bottom of the lake; so that, as the water gets to the leeward side, it is pressed down to a certain distance, but to a certain distance only, a distance depending on the temperature of the upper water, the force of the wind, the area of the lake, and other conditions that I need not specify.

The net result of this contest between the wind, seeking to mix the water and the sun, which tends to keep the lighter water on the top, is that during the warmer season the circulation of the water is confined to a small portion of the lake, a portion which differs in thickness in different lakes. The water moves not along the bottom of the lake but a certain distance below the surface—perhaps 10 or 12 feet down in a small lake, and perhaps 20, 30 or even 40 feet in an inland lake of larger size.

This continued action results in the formation of a comparatively warm layer of water on the top of the lake, within which circulation is going on, and the water of which is more or less continuously turned over and exposed to the action of the air; and beneath that there is a lower layer of water which is cooler, which does not circulate, and which, for a time varying from a month or two in certain lakes to four or five months in others, is shut off from all direct access to the external air by the layer of circulating water on the top of the lake.

You will easily see that the oxygen conditions of the water are very different indeed in these two portions of the lake. The story can perhaps best be illustrated by some of these diagrams, which show in a very general way what goes on in Lake Mendota during the open season of the year.

Lake Mendota, on whose south shore lie the grounds of the University of Wisconsin, is a lake about 6 miles long, 4 miles in width and 84 feet in depth in the deepest portion; several square miles of the lake are more than 70 feet in depth, and the water reaches a depth of 50 or 60 feet pretty close to the shore; the shore is fairly steep, reaching a maximum height of 150 feet above the lake.

Figures 3 to 8 show the temperature and oxygen of the water from April to November, 1905. In each diagram the vertical column of figures represents the depth in meters from the surface down to 22 meters, which is as deep water as you

can find without going too far from our laboratory. The horizontal figures represent two things. They stand, in the case of temperature, for degrees centigrade, and, in the case of oxygen, they

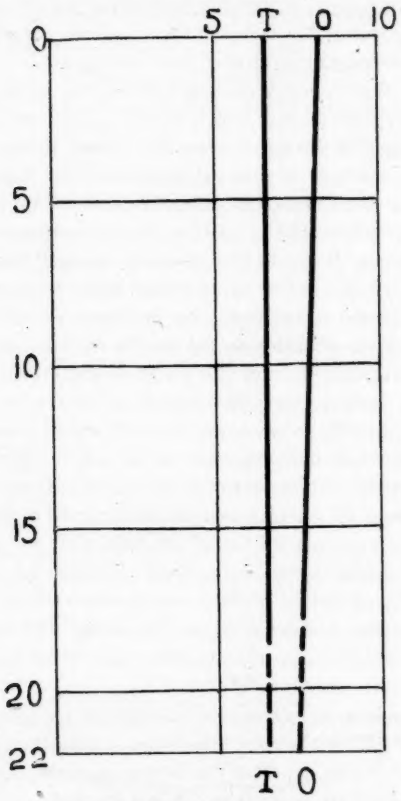


FIG. 3—Lake Mendota, April 22. 1905.

represent cubic centimeters of gas per liter of water; that is, parts per thousand in volume, of the gas in question. The line marked "T" represents the temperature in each diagram and the line marked "O," the oxygen.

In the latter part of April we find a temperature of about 6° C. both at the top and bottom of the lake. There is a very

considerable amount of oxygen, nearly 8 cc. per liter; 8 parts per thousand of volume at the surface and about 7.5 at the depth of 18 meters. I may say that in the early part of the season, for convenience sake, we made our observations in the shallower

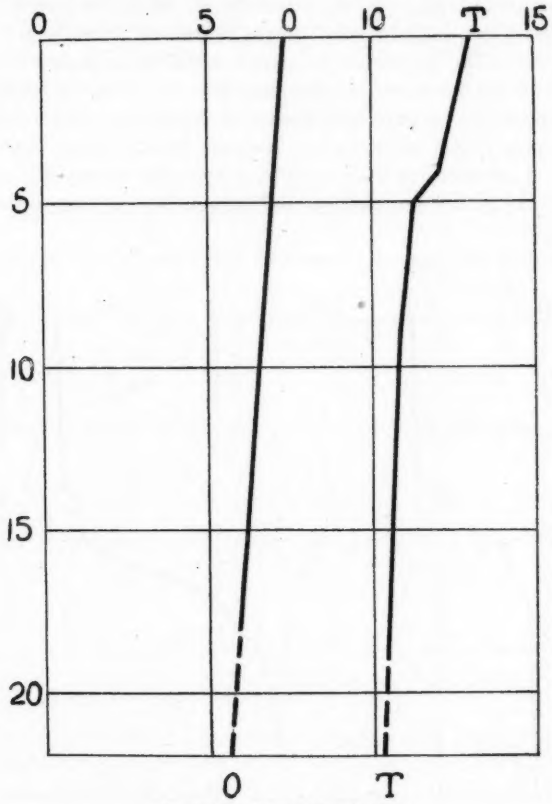


FIG. 4—Lake Mendota, May 24, 1905.

water near the University instead of going a mile or so further to the deeper water of the lake. But the story at this time would be the same in the deeper water, and this fact I have indicated by continuing the temperature and oxygen lines to the bottom of the diagram. In the early spring temperature and oxygen

are substantially the same at all depths of the lake and all portions of the lake support an abundant life.

If now we pass to Fig. 4, which represents the conditions on May 24, you will see that the lake has warmed a good deal—the surface temperature has increased to 13° while the bottom has increased to a little over 10°, but is beginning to lag behind the surface. That shows that the action of the wind is now failing to reach the bottom of the lake, and that as a result the surface is beginning to gain in temperature on the bottom. The amount of oxygen in the surface water has gone down to about 7 cc. per litre; in consequence of the rise of temperature it has declined a little at the bottom, and yet the oxygen line is comparatively straight.

But as you pass into June and July, both as to temperature

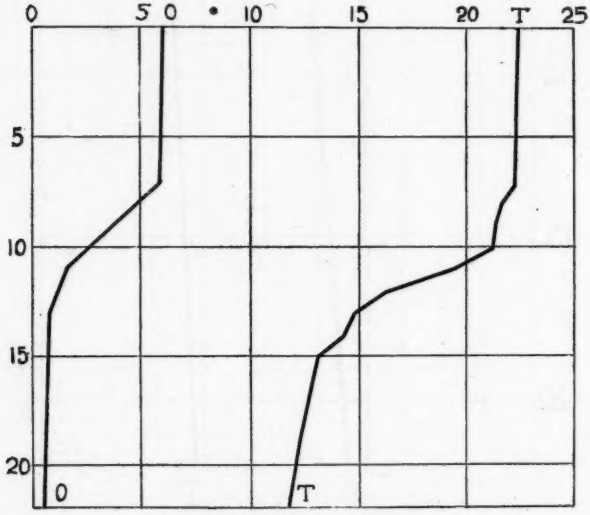


FIG. 5—Lake Mendota, July 29, 1905.

and oxygen the conditions in late July are shown in Fig 5. The surface temperature has risen to 22.6° C, and down to the depth of 7 meters it is almost uniform. At this depth comes a sudden drop in the temperature, which is more marked at 10 meters; the temperature line running down until at the bottom

of the lake it shows 11.8°. The oxygen shows an arrangement corresponding to this division of the lake into two parts; a warm lake 7 to 8 meters in thickness, kept in circulation by the wind and floating on top of the lower water of the lake, whose greatest depth is about 16 meters and which is cut off from the air by the upper stratum. There are about 6 cc. of oxygen per liter in the upper water, but that in the lower water shows the effect of the cutting off of the lower water from new supplies and is nearly exhausted. Its exhaustion is in small part due to the use of oxy-

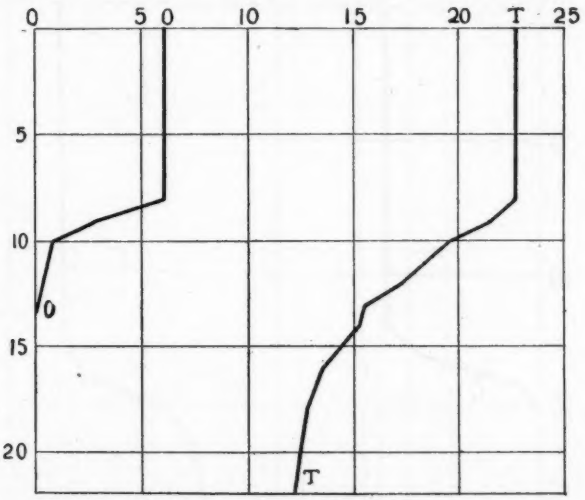


FIG. 6—Lake Mendota, Aug. 31, 1905.

gen for respiration by the animals living in deep water. In far greater part it is used up by decomposition of plants and animals. Down into this lower water are sinking all of the minute dead plants and animals, as well as the larger ones, from the surface of the water; into it is also sinking the debris from along the shore. All of this is decomposed in the bottom water, inevitably using up the supply of oxygen; and that process is showing its effect very plainly from the 7 meter line down. You will see at the 7 meter level the oxygen line begins to curve towards zero and at 13 meters there is very little oxygen left in the water,

(0.8 cc. per liter) and there is even less oxygen at greater depths.

As we pass to the next diagram, (Fig. 6) which shows the facts for the last of August, we find substantially the same arrangement, so far as the temperatures are concerned. The temperature line for the last of August shows pretty nearly 23° C. down to a depth of 8 meters; then comes a rapid fall of temperature, followed by a slower one, until at the bottom a temperature

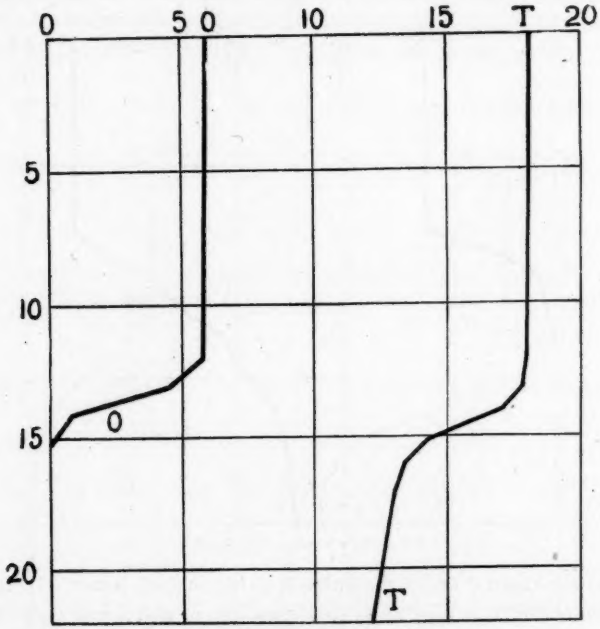


FIG. 7—Lake Mendota, Sept. 26. 1905.

of about 12° is reached. The oxygen of the lower water has been practically used up and ends near the of the cool water.

As the season passes on and the lake cools the upper warmed layer increases in thickness as it declines in temperature. In the latter part of September, as Fig. 7 shows, the circulating part of the lake has reached a thickness of about 13 meters, with a temperature of about 18°. The oxygen has followed on down with

this increase of thickness of the circulating part of the lake—not as fast, since, for reasons which I will not stop to go into, the oxygen follows a little behind the temperature. But the lower, cooler part of the lake is still devoid of oxygen.

In October the temperature falls and becomes practically uniform throughout the lake. Corresponding to this change the

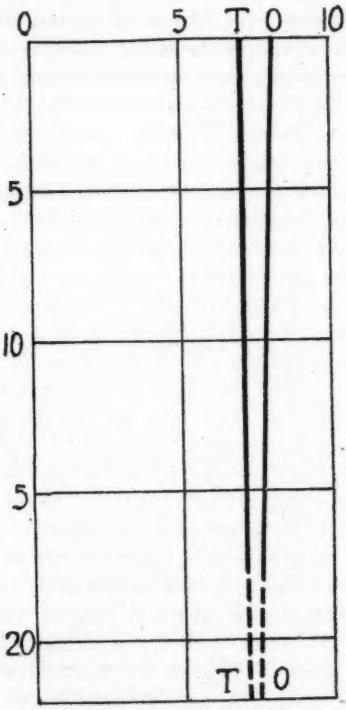


FIG. 8—Lake Mendota, Nov. 9, 1905.

oxygen is found at the bottom of the lake in an amount quite sufficiently abundant to support any sort of animal life. In November (Fig. 8) the temperature has still further fallen, having gone to about 7°., and with the cooling of the water the amount of oxygen which it can hold in solution is increased, the amount has risen to about 8 cc. per liter, and at this time and

later the oxygen supply is rising to its winter condition. In this it will go through the winter and come out in the spring.

The effect of this variation of the oxygen on the life of the lake must be briefly told. My own studies have been entirely on the microscopic life, mainly on the crustacea, though to some extent on the rotifers. If you study the lake in the early spring, when the conditions of temperature are uniform, you will find these animals through the lake at all depths, and in very considerable numbers; and as the spring warming of the lake goes on there is everywhere a great increase in animal life. The algae seem to afford an abundance of food, so that the animal life of the lower types extends to all depths. As the summer conditions come on and as the oxygen begins to be cut off in the lower water, the animal life then becomes, as you would expect, more scanty, and as the July and August conditions succeed, the life in the open water of the lower part of the lake becomes almost extinct. It almost startles the student to see how sharp is the division between the inhabited and uninhabited portions of the lake. If you lower a hose into the lake and pump the water from various depths into a fine net you will catch a great abundance of animals in the water from the lower part of the circulating layer. This stratum indeed is often more densely populated then any other portion and may contain thousands of crustacea and rotifers per gallon. But if the hose is lowered another meter, or even a half meter, an entire change appears. The water is perfectly clear and appears to the eye as fit for life as that above it, but you may pump many gallons of the water without securing more than a very few animals and these mainly sickly or injured forms which have evidently been caught as they were slowing sinking to the bottom. One animal indeed you are likely to find in numbers quite large when its large size is taken into account. Those of you who have studied the animal life of lakes know the transparent larvae of the insect *Corethra,* which is one of the most beautiful and rapacious creatures found in our lakes. This is practically the only animal that you will find inhabiting the lower water. It comes up into the surface water at night, feeds, renews its stock of oxygen, which it stores in sacs, and goes down again for the day into this water devoid of oxygen. In such water it seems to be thoroughly at home and indeed we have

learned that its presence in water pumped from a lake during the day time indicates that there is little or no oxygen in that water.

Thus the story of the oxygen is of great importance to the life of the lake, because during the months of July, August, September, and the early part of October, all the lower part of Lake Mendota is almost uninhabitable by any animal. There are a few creatures that live in the mud; there is found there a species of clam, (sphaerium) about as large as a pea when fully grown. In spite of the fact that the water above it, and around it, is devoid of oxygen, that animal survives apparently in a dormant condition. We have pumped up the mud from Lake Mendota with these animals in it, and kept them under observation in sealed bottles, so that the conditions of life, so far as temperature and oxygen were concerned, were the same as at the bottom of the lake. We found that the animals would continue to live, although in a dormant condition; while if taken out and placed in water which was aerated, the clam would quickly begin to put out its siphons and feed. There are also worms found in the mud, but the life at the bottom is very decidedly scanty and poor, and one which is not fitted to support any considerable amount of fish life at any time of the year.

This story of the oxygen as shown in Lake Mendota is repeated in principle in all lakes; but the details of the story, and the effect upon life are very different in different lakes. All of the lakes get during the late fall, before they freeze, practically as much oxygen as they will hold at the temperatures which they have reached; they come out in the spring with substantially that amount of oxygen. The formation of the warm surface layer comes at different times in different lakes. In the small lakes it comes early in the spring, late in April, or early in May. In lakes of 20 or 30 acres the warm layer will be formed at that time and the bottom water is then cut off from access to the external air. In lakes of a mile or two in length this formation comes late in May or early in June, and at that time the lower water will be cut off. In the larger lakes from 6 to 8 miles long, like Lake Mendota, Lake Geneva or Green Lake, the final formation of this layer is still further delayed until the latter part of June or

early July; so the bottom water is cut off from access to external air for very different lengths of time in different lakes.

And still further: The amount of the oxygen in the lower water depends not merely on the length of time that the bottom water is cut off from the external air, but it depends also upon the amount of decomposable material discharged into it by the upper water and on the volume of lower water, which depends on the depth of the lake. If the amount of life in the lake is small, the amount of material which will decompose in the bottom water is extremely small, and the exhaustion of the oxygen goes on with corresponding slowness. If the volume of the lake is great, as in Green Lake (237 feet deep) the amount of oxygen is correspondingly great, and it is not rapidly used up. If the lake (like Mendota) has an enormous amount of plant life in the upper water, so that there is a continual and rather rapid rain of organic matter dropping down in the lower water, decomposition goes on rapidly, aided also by the comparatively high temperature of the bottom water, and the oxygen is exhausted at a comparatively rapid rate.

Then again, in case of the smaller lakes, the amount of discomposable matter coming in from the margin of the lakes increases proportionately—the smaller the lakes the larger the margin with reference to the volume of the water of the lake. There is a zone around the edge of any lake in which the bottom plants will grow. This zone does not differ in breadth in proportion to the size of the lake, so that in a small lake the central part which is free from bottom growth is much smaller proportionately than in the larger lake, and the material washed into the deeper water from the margin and the banks is correspondingly greater in the smaller lake. Then, too, the leaves which are blown into lakes of 20 or 30 acres in area, or even larger, form a very important addition to the decomposable material on the bottom. The result of all this, in those small ponds and lakes so common in the kettle moraine of Wisconsin, is that the bottom water is cut off from access to oxygen at an early period in the spring, and a great amount of decomposable material of all kinds is present in the lake. It follows that there is a long period during which there is no oxygen in the lower water, and consequently no animal life, and the bottom of the

lake is composed not of mud but of partially decomposed organic material in which no higher organisms are able to live.

I have indicated in diagrams, some of the conditions which we find in certain of these other lakes, to show you some of the variations which may occur.

I will speak first of Green Lake, which resembles much more nearly the condition found in the Great Lakes than does any other inland lake of Wisconsin. This is a lake of some 8 miles in length, 2 miles in width, with a depth of 237 feet. It is 100 feet deeper than any other inland lake in Wisconsin. The life of the lower water of Green Lake is not very different from that of one of the Great Lakes, and when we note the oxygen story, we can see some reason for this fact.

Fig. 9 shows the distribution of temperature and oxygen on September 6, therefore comparatively late in the summer season. You will notice that in this diagram each vertical space stands for 10 meters instead of 5, as in the case of the other lakes, while the horizontal scale is the same as in the other diagrams. The lake shows a temperature of about 21.5° C at the surface, falling slightly to a depth of 9 meters, and then declining rapidly to about 20 meters. From that point to the bottom the decline is slow until at a depth of 70 meters a temperature of 5.7° is reached. I may say in passing that there are no lakes in Wisconsin in which the bottom temperature remains at 4° C during the summer. Even in this lake, 237 feet in depth, the bottom temperature is always greater than that of the maximum density of water. The action of the wind in the spring is sufficient to circulate the whole mass of water and to give it an opportunity to warm up a degree or two above the temperature which gravity alone would give it. The distribution of oxygen is quite different from that shown in any of the preceding diagrams. At the surface the amount is about the same as in other lakes and there is a marked decline in the oxygen at the upper part of the cool water. Then the oxygen begins to increase, becomes greater than the amount found at the surface, and at the depth of 40 meters is nearly 7 cc. per liter. From the depth of 50 meters it declines, until at the bottom only a fraction of a cubic centimeter is left. This abundant supply of oxygen in the lower water depends on the great volume of this water in comparison to the amount of

decomposable matter discharged into it. The water absorbed large quantities of oxygen during the fall and winter and only a part of this stock has been exhausted, most rapidly at the bot-

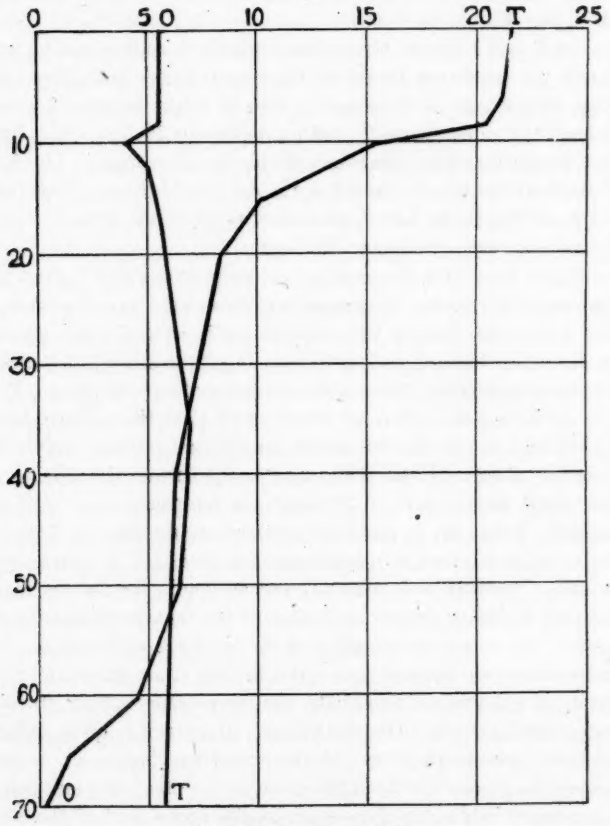


FIG. 9—Green Lake, Sept. 6, 1905.

tom and at the upper part of the cool water—the two places where the greatest amount of chemical activity seems to take place. The oxygen nowhere becomes so low as to make it impossible for a considerable number of animals to live in the water and in the mud beneath it.

Green Lake is the only lake in Southern Wisconsin in which an oxygen curve of this character could be drawn. In most lakes the bottom water is practically devoid of oxygen in September.

In Lake Mendota the whole of the cooler bottom water becomes oxygen-free at a comparatively early period of the summer and there is a long period there when the lower water cannot be utilized by animals. If this statement were true of all lakes, the smaller lakes would have only a very shallow surface stratum which could be utilized. But in many smaller lakes an operation goes on which materially increases the amount of oxygen and the thickness of the stratum of water which is inhabited by animal life. Figure 9 shows the distribution of oxygen found on August 16 in Beasley Lake.

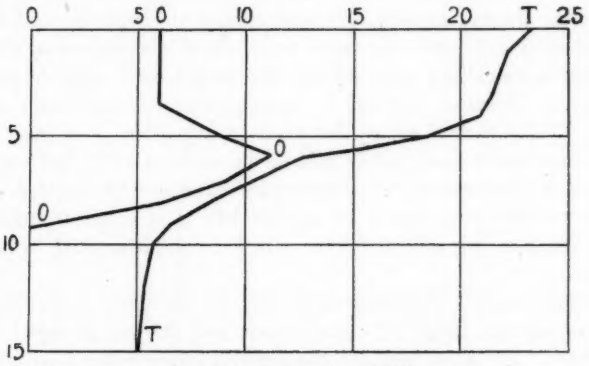


FIG. 10—Beasley Lake. Aug. 16, 1905.

Beasley Lake is a little lake about one-quarter of a mile long and half as wide, a kettle-hole, one of a chain of lakes at Waupaca, in central Wisconsin, and one which shows, by the way, about as low bottom temperatures as any Wisconsin lake. You will notice that the temperature of the water begins to fall at a depth of 4 meters, or only about 13 feet below the surface. You will see also that the oxygen curve does not follow the temperature curve as it does in Lake Mendota, but that instead of decreasing the oxygen increases in the cooler water, so that at a depth of 6 meters there is a very large amount—11.2 cc. per liter. At 8 meters there is still as much as at the surface but

below this depth it rapidly declines until a little below 9 meters no oxygen is left. This lake gets from the surface water and from the shore a great amount of decomposable material and one might expect that the oxygen would be very promptly exhausted up to the top of the cool water, especially as the warm upper stratum is formed early in May or even late in April. The diagram, however, shows that the facts are very different and that the upper part of the cool water, so far from being poorer in oxygen than the upper stratum, has a much larger amount. The cause of this great amount of oxygen is as follows: The transparency of the water is such that the algae of the water can grow at a depth considerably greater than the top of the cold water; and these algae, lying as they do in the water which is not distributed by circulation, the cool water lying below the warmer stratum, get light enough to utilize as food the carbon dioxide and the other products of decomposition that come to them, and they liberate free oxygen as a result of that process. Thus we get in the upper part of the cool water not merely the normal supply but an over-saturation of oxygen, an amount which could not be held in the water at all if that water were at the surface. In this way the thickness of the layer of water which is available for animal life is practically doubled by the presence of the oxygen which is manufactured by the plants.

The diagram of Elkhart Lake, Fig. 11, shows the same thing. This is a lake about 110 acres in area, and 112 feet in depth, 34 meters. The upper stratum, the layer of warm water, is about 6 meters in thickness, and the temperature falls off very rapidly from that depth. At 6 meters the oxygen begins to show an increase; at 8 meters a maximum of oxygen is reached amounting to more than the 11 cc. per liter. It does not begin to fall off very greatly until 10 meters have been reached, and even at 12 meters there is still a somewhat abundant supply. From that point it declines until it practically reaches zero, although it does not get absolutely to zero at any point in this lake—at least not in August, so far as our observations go. So that in this lake also the stratum which is available for animal life is by this action of the plants increased from a thickness of perhaps 6 meters to 12 or more meters.

How great an effect the condition of the gases may have on lakes can perhaps be well illustrated by a lake whose gases have not yet been investigated. Mr. Hankinson who is studying Walnut Lake in Michigan, has been telling me today of the results

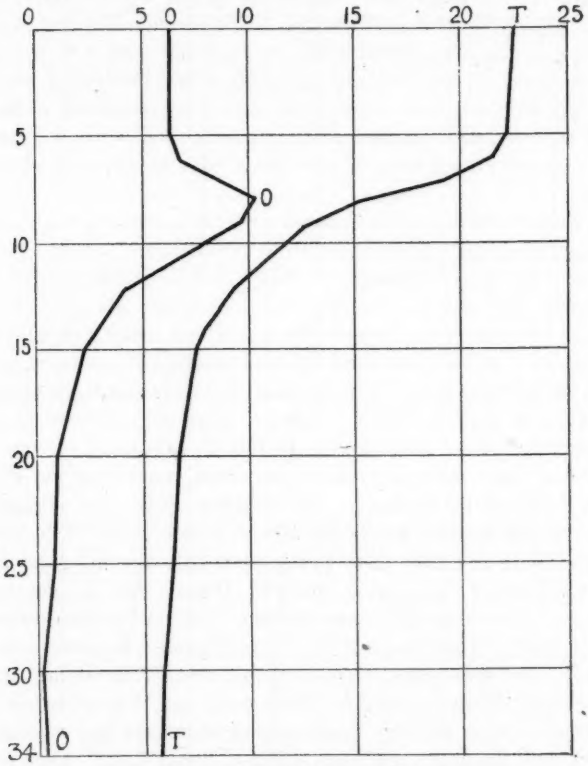


FIG. 11—Elkhart Lake, Aug. 23, 1906.

he has found in the study of the life of that lake. The lake is about a mile in length and half that in breadth, and 110 feet in depth. It is a lake that is not far different in these conditions from Rainbow Lake, Okauchee Lake, Nagowicka Lake and numerous other lakes in Wisconsin.

In Walnut Lake as I am told, the bottom is very thickly

covered with insect larvae which are living in the mud and feeding on the lower organisms which live at all depths, and both insects and lower crustacea supply food for fishes. I think the true whitefish is found in fair numbers in this lake. Now our southern Wisconsin lakes lack oxygen in the bottom water; insect larvae, therefore, cannot live at the bottom. Oxygen is cut off from the lower water early in July and does not increase there again till October; and the result is that the bottom waters of our lakes are poor in life, and there is no possibility of raising in these lakes those fish that must live in cool water and must find in the deeper parts of the lake a large supply of food and air.

I have added another diagram (Fig. 12), showing the distribution of oxygen and temperature in Trout Lake, as found by us during the present season and which perhaps shows conditions a little like those of Walnut Lake. This lake has a depth of about 100 feet, with a length of about 4 miles, and a breadth of 2.5 miles. It is in two parts, however, which are connected by a narrow opening only. The diagram is taken from the southern and larger portion, which is about 2 miles long, divided by islands into two or more basins. In this true whitefish *(Coregonus)* and lake trout are found; the latter inhabiting the deep water during the summer. The diagram shows that although the oxygen declines in the lower and cooler water, it declines very slowly and that there is a considerable amount until the very bottom of the latter is reached. Down in the oxygen-poor water at the bottom lake trout are able to live, as our observations have shown. There is a marked contrast between the oxygen content of the lower water in this lake and that of any of the lakes of similar depth in Southern Wisconsin, and this difference is probably due to the very small amount of animal and vegetable life found floating in the open water of Trout Lake. Very few lakes in Northern Wisconsin have been examined carefully, but Trout Lake is the poorest in this respect of all the lakes which we have studied.

The oxygen and other gaseous conditions of the water in general and of the bottom water in particular, are prime conditions of life, which determine not only the lower life but the possibilities of the higher life of the lake also; and for this reason I

have brought the story thus briefly to your attention. The whole subject of the gases dissolved in the waters of the Wisconsin lakes is being studied by the Wisconsin Geological and Natural

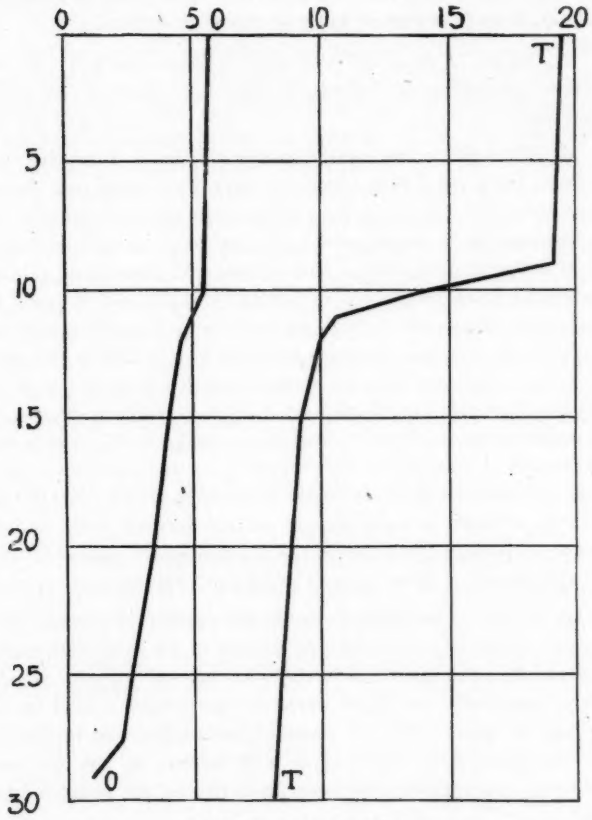


FIG. 12—Trout Lake, Sept. 7, 1906.

History Survey. We began the study last year and the field work is continued during the present season. We shall expect to publish at an early date a full account of the results of our investigations.

Mr. Titcomb: I want to ask Dr. Birge if he has in any way observed the movement of fish with reference to the changes in temperature of the depths. Take for instance, the lake trout which inhabit the very deep waters in August, and in June, we will say, is in four feet of water or near the surface.

Dr. Birge: I have not been able to follow the fish. As yet we have not had money enough to chase both gas and fish at the same time.

Mr. Titcomb: One more question: This is a subject that interests me a good deal because I have for a long time had a great desire to locate a hatchery with a lake as a water supply for the propagation of salmon and trout, and have an unlimited supply of water from the lake. Now almost every trout and salmon lake that I know of gets too hot on the surface, and it would be practically impossible to take surface water from even a trout lake of large area and supply a hatchery to rear fish in the summer time. My idea was to regulate the temperature, possibly varying it to suit conditions by taking it at varying depths. I am surprised to see there is so little variation in the first 8 meters, because I have tested lakes where there was much more variation in less depth, but this brings in the subject in such way that when we consider a water supply of that sort we must go into it more fully than I had thought, and consider the supply of oxygen and action of gases, as well as of temperatures.

Dr. Birge: The depth to which the warmth of summer will extend is primarily a function of the size of the lake. Of course granting that the lakes are in the same general region. A lake further north will not be as warm as one further south; but in the case of lakes within 50 miles of each other, the larger the lake the thicker the warm layer will become, as you will see, when you understand it depends primarily on the action of the wind.

You will notice in the diagram of Lake Mendota the cold layer starts at 8 meters and goes down to the bottom. In Elkhart Lake, which is only 110 acres in extent, the warm layer s about 5 or 6 meters in thickness; and in Beasley Lake the warm layer is only 4 meters in thickness. The warm layer in August in this lake is about as thin as you can find it in anything you

can call by courtesy a lake. A lake of 15 or 20 acres will show as thick a layer as that. So that you have got to go deeper than that for cold water. If you think of using a lake in the way you speak of, you ought to visit the lake in August or in September, and ascertain what the gas conditions are in the lower water. In the cool water from Lake Mendota, the fish will die quicker than on land. If you put a fish into this water and keep him where he cannot get his mouth out, and get air, and he will keep his gills working with the result that the oxygen will get out of his blood instead of going into it; whereas, if he were out on land, he would simply wait until he had used up himself all the oxygen which he had. There are other gases which develop in the lower water, but so far as I know, those gases are not directly poisonous to animal life. The carbon dioxide does not seem to affect the animal life directly. But the question of the amount of oxygen is very important. You could pump water out of the deeper waters of Green Lake, for instance, to supply a hatchery and it would be perfectly satisfactory, so far as oxygen is concerned though I am not sure that you would not be troubled even in that water with an excess of nitrogen.

Mr. Titcomb: That would readjust itself quickly in flowing on the surface.

Dr. Birge: Yes, but the water would also become warm. It is a question whether you could get rid of excess nitrogen without warming the water more than you want to.

Mr. Titcomb: On a rapid current a stream does not warm up very quickly.

THE FISHERMAN AND REFORESTATION.

BY FILIBERT ROTH.

That the forest cover influences the distribution of water on the earth's surface in place and time, that the forest helps to store up water, and tends to make our streams more ample, more clean and more regular, preventing flood and drought, all this is matter of common belief. That this belief is held by at least a part of the members of this society, I take for granted, otherwise the matter of reforestation could have no place in your discussions. It is to be regretted that this relation of forest and waterflow should still be a debated question anywhere, and that we should lack reliable and accurate data to substantiate the commonly accepted belief. This is the more unfortunate, since we, right here in Michigan, have had perhaps a better opportunity to trace, step by step, the changes brought about by the removal of the forest, than is found in almost any other part of the world. And even today these changes are going on; springs are drying up along our Huron River banks, little streams are changing to dry runs; wet fields are gradually drying up; thousands of acres of swamps are changed to meadows, miles of corduroy road are thrown out and changed to dirt road. Even in our north counties, where no clearing, no settlement has helped matters along, we find old cedar stubs on what is now dry sandy pinery land, clearly showing that when the forest was intact the moisture loving Arbor Vitae had no trouble in growing out of the regular cedar swamp. But these facts were not recorded, they did not lend themselves to easy and yet accurate observation like temperature and rainfall and the consequence is that we have to go and see and infer.

In considering the action of the forest in regulating the distribution of water we may assume as proven by the experiments of Wollny and others that:

The forest holds the soil, it prevents the erosion as no other cover does. The great significance of this one action is difficult to overrate.

The forest serves as a mechanical barrier to a ready surface run-off. The forest keeps the ground in a more receptive condition and thus facilitates the soaking in of water.

The forest forms a large "brush cover" acting like an artifical cover of any kind, and thus reduces the action of wind and sun. The forest is a shelter house and thus produces conditions which tend to preserve moisture, exactly as the walls and roof of a green-house do.

That the forest as a mass of growing plants also uses up moisture and thus wastes exactly what we claim that it conserves, is understood.

Keeping these facts in mind, it is clear that a forest covered area may be regarded as a reservoir, that the greater this reservoir, the more moisture and vice versa. Also that if all land is forest, there comes a time when equilibrium is reached, and that if all forest is removed there will finally come a condition of equilibrium, in keeping with these new conditions.

Our prairies and some of the large provinces of China are perhaps in this cleared land-equilibrium. A hundred years ago Michigan was in a state of equilibrium as to water distribution and especially in the southern half, it was rather too wet for safe and comfortable human habitation. Since then the surface has changed, a large part of the forest is gone, the surface run-off is made easy by cleared land, furrow and ditch, and we are gradually approaching another equilibrium, probably less satisfactory than the first. The gullying and washing of our lands, flood and drought have caused people to become alarmed at the prospect of drifting into an unsatisfactory extreme and the municipalities affected by floods, the water-power men and other industrials like yourselves have joined hands with the forestry people to see if the matter might not in some way be modified and serious losses averted.

Believing in the influence of the forest, the reforestation of denuded lands naturally suggests itself as one of the most reliable means.

To the fisherman this reforestation is of importance in various ways and to various degrees. To beautify the stream and landscape, to shade the water and affect its temperature; to keep

the waters clear and pure, and lastly but most important of all. to keep a steady flow.

Even a narrow fringe of forest along a stream will lend beauty to the landscape and suffices to shade the stream if small. But to keep the waters clear and pure more must be done, and still more is necessary to regulate its flow and maintain an ample supply of water. At this point we still make the mistake of supposing that the reservation of a few townships at the head of the Arkansas is going to regulate its flow. This is a fallacy and should be avoided. Every little helps, and it is gratifying to see any attempt made, but for final success it is necessary to be clear as to the truth in the case. To regulate the Grand River and have it as it was 100 years ago, all the land tributary to the stream should be woods; and to have a decided influence in staying its erratic behavior more is needed than merely a few acres of woods at one or a few of its sources. How much is needed? No one knows; but so much is certain, the condition of every acre of land tributary to Grand River has its influence however, small, on the magnitude of the flood or the duration of a drought. What is true of Grand River is true of every stream, modified by the many conditions peculiar to each.

But will reforestation prove a feasible means? Certainly, but in most cases it will mean a task of some magnitude, and to underrate this is a sure beginning of a failure. Many conditions necessarily enter the first considerations of such problems. In Iowa where ninety per cent. of all land is real plow land, reforestation must remain in the background, and the plow receive a first consideration. In New England where probably not over thirty per cent. will ever prove proper plow land, the case is reversed. The same comparison holds between Wayne county and Crawford county, or the upper peninsula.

Generally it may be said, the mistake is made in our country in overestimating the value of the agricultural uses of the land. The clearing and settling craze is still on, and we are apt to forget that much land may be of far better use if left as woods, or restored to forest. In our own state we have dozens of fine streams running through lands on which the state has been losing money trying to force settlement. Such areas ought to remain

forest, the bare lands should be restocked, and timber and water, fish and game should have their proper attention.

Once a project of this kind is decided upon, the methods of doing are simple. But here again let me warn against half doing. If we go into it let us make sure that the tree we plant receives the protection without which all forest growth is impossible. It is useless to plant forest and then burn it up.

With every larger enterprise it pays to survey and map the land, maintain a home nursery and raise the needed plant stock, and in all cases have a man trained to the business. What to raise will depend on the land. On better lands the hard woods have the advantage of being useful early, of sprouting and thus saving expenses in starting new growth. On our sandy lands, and also in handling the Northern swamps the conifers are the principal trees we must look for.

The expense of starting a forest is usually much overrated. Five dollars per acre will do very well, and ten dollars is an ample outside allowance.

On larger areas the protection of the lands should receive close attention, and in no case should this be left to a mere "put out fires" enterprise. Patrol, rigid, regular, and ample patrol is the only satisfactory method. But will this pay? Always! provided we apply a reasonable amount of forethought and economy. The little tree costs less than a cent to put in the ground, it is worth at least one dollar when fifty years old. But here let me warn against rash expectations. Forestry is not a speculative, promoters' business; it is a form of agriculture, and though generally the safest form, forestry, like other branches of this business, pays only a modest per cent on the investment. Nevertheless, if the state of Saxony can make five dollars per acre per year net, we ought soon to make one-fifth or one-third of this, and thus do better than that continuous failure performance of would-be farming on poor land.

Reforestation in our state, as in many others, is needed and must come. It is a great problem and a problem which needs thorough consideration from all standpoints. For its success it needs considerable legislation and recognition on the part of our statesman and local authorities. It needs notification of the atti-

tude of state to its own and private property, and it needs much education among our people.

To bring these about it needs concerted action on the part of all those interested in this subject, and it is for this reason that I thank you especially for this opportunity of saying a word with regard to the greatest economic problem before our people.. (Applause.)

NEW TYPE OF JARS FOR HATCHING.

BY W. E. MEEHAN.

Some superintendents of hatcheries in Pennsylvania were not perfectly satisfied with the type of jars used for hatching and asked me to try to design something more satisfactory.

I designed a jar which is now in use in some of our batteries, and I believe is in use in one other state and is giving entire satisfaction. There is no patent on the device. There is no contraction at the top, the lip is much larger than in the other jars and wider, and the stem is done away with and a simple plate of glass set on the bottom. The bottom is round and formed like the bottom at the McDonald. This jar will hold as many eggs as the Chase or Downing jar, and more than the McDonald, and can be set up close to the battery. The jar not needing as large a lip as is necessary on some jars, because of the body being perfectly straight, allows the jar to set close to the trough; the amount of water required is not so great as is necessary in certain types of jars. A small amount of water will keep the eggs moving very nicely. We have been using it in our hatcheries with very great success and the men believe it to be better than some of the types that we have been using heretofore. One other state also has been using it with marked success.

Mr. Clark: What is the difference between that and other jars; I cannot see it.

Mr. Meehan: The Downing improved comes in this way:

The McDonald jar is shaped something like this:

which makes it difficult to clean, and so with the Chase jar.

My jar is shaped like this:

It is much easier to work and wash than other shapes are, and holds a maximum amount of eggs, which work more easily and regularly than any other jar excepting the McDonald, at least so my superintendents aver.

Dr. Bean: The state of New York has a few of the new jars referred to, and the men who are using them like them very much. They say that they are easier to clean, they stand closer to the battery, as Mr. Meehan said, and they increase the capacity of the hatcheries by about 20 per cent. for the same water.

THE BASS AT THE MILL CREEK STATION.

BY DWIGHT LYDELL.

In a letter from our Honorable Secretary, a couple of weeks ago I was asked to contribute something in the way of a paper, no difference how brief, and as to briefness I think I have you all faded.

The bass at the Mill Creek Station are now in the pink of condition, but this could not be said of them last spring. One year ago last month we lost the most of the S. M. stock fish at the Mill Creek Station by flood. What few were left (about 20 in number, were transferred from our regular breeding ponds to a much larger pond, for the reason that the breeding ponds had to be kept dry for some time in order that a cement wall might be built to protect us from farther damage by flood.

After transferring what few breeders there were left, other stock was procured from outside waters and placed in the same pond, but we were never able, until this spring after the spawning season, to control these fish, or in other words, get them to come to any certain point to feed, in fact they had no food except what was in the pond, this consisted possibly of a few crawfish. The outcome was that they were in rather poor condition when the spawning season arrived this spring.

From the first spawning about 60 of the 78 beds in the pond, were covered with eggs, these I have no doubt would have come through in good shape only for cold weather that drove the temperature of water from 62° down to 47°, where it stayed for two days. The outcome was that the bass deserted their nests, and the whole business went up in smoke. Probably from this spawning there were 300 fry hatched. Why these 300 escaped I do not know, and was too disgusted at the time to try and find out.

After the water had warmed up again another spawning was found to have taken place, about 40 beds being covered with eggs. These seemed fairly good, but the adult or parent bass were so blooming hungry by this time, that they turned in and ate up

nearly the whole lot of eggs, rooted up the nests, and raised cain generally, only 6 good nests coming from this spawning.

Fearing that the small mouth work at the Mill Creek Station was going a glimmering for 1906, I became desperate, and upon learning that S. M. were being taken at Newaygo, from the Muskegon river, Mr. Otis Monroe, the foreman at the station was sent at once to that point. He returned with 20 nice specimens, which were placed in a spawning pond, and beds placed therein. These fish had not spawned when we put them in the pond, and have not yet done so to my knowledge.

About the time that the fish were secured from Newaygo we learned that some S. M. were being taken below the dam here in Grand River. I immediately hied myself riverward and secured twenty-six more S. M. specimens. These fish were little fellows, but healthy looking chaps, and as soft as mush. Twenty of these were placed in one of the smallest spawning ponds at the Station and six were put into one of the regular spawning ponds. From the twenty in the small pond we got seven as nice beds as I ever saw. They spawned the next day after being placed in the pond. From the six that were put in the regular spawning pond we got two nice beds, one pair spawning on the plank at the outlet, and the other pair spawned on the roots of an old stump that was left in the pond when it was built. They spawned before we had time to put in the gravel. This is the first time that I have ever got any fry from S. M. bass introduced into the ponds in the spring, and I think that if these had been put in two weeks earlier nothing would have come from them. The latest that S. M. have know to spawn at Mill Creek occurred this year, one nice bed coming off the 22nd of June.

The stock fish at the station are now in excellent condition, and are feeding nicely on liver, so we expect to get back into the old channel another year and do business again.

The Large Mouth at Mill Creek have covered themselves with glory this season, and nothing farther could be asked of them. They commenced spawning in the fore part of May, and continued to spawn until the middle of June.

An experiment was tried in feeding some L. M. advanced fry this season that will no doubt be of interest to some of you. Five hundred of these fish all about ¾ of an inch long were

counted into a screen and placed in a small narrow pond, with a good current of water running through the screen. These fish were fed entirely on the so-called Chicago fish food, (showing sample). They were fed nearly every hour for 10 days, when those that had not starved to death were so weak that they could hardly swim, so I concluded that as far as Chicago was concerned it is out of the race for the present as to food for L. M. bass fry. I intended trying many other experiments in feeding bass of this length, but, my time being taken up with shipping and other work, could not get to it. If there are any members here who have tried feeding these fish as fry, would be pleased to hear what success they have met with.

The output from the Mill Creek Station this season up to July the 14th is as follows:

Small mouth No. 1 fingerlings.....	8,000	
Small mouth No. 2 fingerlings.....	31,500	
Total.....		39,500
Large mouth, advanced fry.....	474,000	
Large mouth No. 1 fingerlings.....	318,000	
Large mouth No. 2 fingerlings.....	21,500	
Large mouth yearlings.....	1,004	
Total.....		814,504
Grand total.....		854,004

We still have 1,000 yearlings to ship and I think 50,000 a fair estimate of what fingerlings there are left in the ponds. None of the ponds has been drawn off, so it is somewhat hard to tell.

DISCUSSION.

Mr. Titcomb: Do I understand he got 800,000 and odd bass from this station this year?

Mr. Lydell: That includes three auxiliary ponds that you do not see here.

Mr. Titcomb: As large as these?

Mr. Lydell: Yes, two of them larger than these.

Mr. Titcomb: It is extremely good work even then. The

superintendent of the Manchester Station actually tried an experiment which I attempted but failed in through not having my ponds in proper order. He placed his bass and fry when they rose from the bed, in nursery ponds of the size of about 75 x 20 feet. They had not been in use and contained a great deal of natural food and the fry fed on this natural food in these nursery ponds until they were sufficiently large to take maggots. Then he suspended the maggot trays over the water and the little bass came up and assembled under the trays and took the maggots greedily. He does not know yet how many fish he has caught there, and that would be a very important point. At the St. Johnsbury Station there are a lot of nursery ponds much smaller than those mentioned, which had no fish in them, and when I was there I noticed that those ponds were filled with animal life early in the spring, if they were left empty of fish; and we wanted to try the same experiment there. There is a good idea in that, in getting your small mouth bass spread out to get food, and still have them under control.

Mr. Meehan: We tried maggots with some success at the Wayne hatchery. At Torresdale we had ponds about 30 feet by 15 feet. There was a large quantity of live food in those ponds and in addition to that the fish were fed with ground fish which they took very greedily, four times a day. But neither maggots nor natural food seem to have reduced cannibalism very much. We placed 14,000 fish in those ponds and at last accounts we had taken out 3,000, and there were left about 2,000.

Mr. Clark: They talk about maggots on which to feed small fish, but they do not mean for feeding the fry just after they come off the nest. What has anybody tried as to feeding fry as they come off the nest?

Mr. Seymour Bower: You mean for feeding with artificial food?

Mr. Clark: Yes, or doing anything to increase the natural food—that is where we are weak. In this connection I might say that this season we put 10,000 fry directly from the nests into one pond at Northville, and counted 8,325 number two fingerlings.

Mr. Meehan: That is better than I did in mine.

Mr. Nevin: Last fall at Dousman where we have no buildings and no tanks, when the fry commenced rising off the nests, we got two big farm tanks, 10 feet in diameter, and placed these below the dam and ran a pipe from the pond into the tanks, and with one lift of the net we could raise up half a pint of bugs, and we would put a tubful in the tanks and the fry would go after the bugs like brook trout go after liver. We did that two or three times a day; it was just like fattening a lot of hogs. We did not lose any fry, they fed well. There was an abundance of food and from this pond we shipped 600,000 large mouth bass, and expect to ship 400,000 more.

Mr. Clark: What kind of bugs were they?

Mr. Nevin: A good deal like the common louse.

Mr. Titcomb: Is it daphnia?

Mr. Birge: No, but of the same group.

Mr. Nevin: The pond was filled with them. At Minocqua station many died from scarcity of food and we could not hold them any length of time, but had to ship them as soon as we brought them in.

Mr. Titcomb: On this subject of food of that sort, there is a great field for investigation. Mr. Atkins has tried experiments with manure to produce this minute animal life. It does produce it, and ordinary refuse and straw will produce it, and the killing of the algae with copper sulphate will increase the daphnia and cyclops, for a time. We had an interesting experience at the fish pond in Washington this year, where one small pond had been enclosed for a number of years to keep a pair of fancy Mandarin ducks. It had never been cleaned out, and the ducks had occupied the pond every summer for a number of years; we found this year that we could gather this daphnia, bucketful after bucketful every day, for two or three weeks, and possibly they are doing it still; that food is suitable for the bass when they are ready to take food. That is the kind that we want to encourage I suppose, in this nursery pond project which I suggested, leav-

ing the ponds natural, and possibly putting in manure of some kind until we introduce the little fish where nature has already provided food which carries them along until they take something larger.

Mr. Lydell: We have no trouble here in getting plenty food for the fry. The trouble arises after they become an inch long, or a little less; that is where we lack for food. Our food was most plentiful this year in ponds which had been dry during September and October. Those ponds this year were one teeming mass of daphnia. We put in our small bass fry and after they were three-fourths of an inch long they cleaned up the mass and then they lacked food.

Mr. Titcomb: That is where maggots would come in.

Q. Do you keep any of your ponds dry through the winter?

A. No.

Q. Just through the fall?

A. We had to run them dry on account of putting this wall in—that was the only reason.

Mr. Titcomb: I have heard of a food used called the Chicago food, and I would like to inquire what that is.

Mr. Meehan: It looks a little bit like Indian meal.

Mr. Lydell: Yes.

Mr. Meehan: We tried it on trout and it bound them up like a bullet.

Mr. Lydell: We had some bass in the same pond; there was a nice current formed through the screen and by stirring this food up it went down this current and looked as much like daphnia as anything you could get, and I thought it would be quite valuable, but these bass would just give it a wise look and walk away, and they would starve to death before they would take it.

President: Are there any further recommendations of this Chicago food?

Mr. George Morcher: This is my second year in which I have used that Chicago food, but I use one-third of middlings and two-thirds of meat.

Mr. Meehan: This is a powder, is it not?

Mr. Morcher: Mine is a little coarser than corn meal, but fish under an inch and a quarter in length wont take it; after that my inch and a quarter fish, as long as I keep them confined at the hatchery, take it readily, and with no bad results.

Mr. Titcomb: Bass?

Mr. Morcher: Yes.

Q. Large mouth or small mouth?

A. Both. The small take it more readily than the large. If I put in a school to-day it makes no difference how many insects I have, I grind a good butter cracker, about as fine as corn meal, and on the outer edge of the pond I drop that in here and there and it floats. I have watched bass which would not eat until they were ten to twelve days old and they will go right to eating, and they will follow you along and pick this cracker up. Now I feed them about fourteen days on that same size of ground cracker, then I begin to put in a larger cutter, until they get to be about one and one quarter inches long, and then I use Chicago meat with these middlings. I cook it in the morning, cover it up in a tight vessel and let it set until four o'clock in the afternoon, and feed from four to six p. m., two men taking it around, using it for all spawners as well as fry, and I do not think anyone could have had a nicer lot of fry in small-mouth bass than I did last year. From the 10th of May up to the 15th of September they grew from two and a half to seven inches; and there were 150 taken out of there from four and a half inches to seven inches long—and I must praise the Chicago meat.

Mr. Titcomb: You cook it in with middlings?

A. Yes.

Q. How long do you boil it?

A. Just long enough to get it thoroughly stirred through. I get a farmer's kettle and it holds fifteen gallons. We have to

put in enough water to the meat to make it just the same as your wife makes mush out of corn meal—thick and a little crumbly. Where we feed it to small bass we take it in our hands and loosen it up and scoop it up over the water. The bass, catfish and croppy fry or fingerling pick it right up as they go, and they fatten on it.

Saturday evening we had something peculiar happen. I was walking along after the men had fed the fish. They practically had got through, and I passed a small mouth bass pond where I had this in, and as I was walking along noticing the west pond I saw a fish coming out of the deep water. He made a dart for the shore, and when within a foot of it whirled on his head with his mouth open and darted around. I asked for a cheese-cloth net and caught him and found he was dead. I examined him and found nothing on the outside that showed any signs of injury. I took him up to the house where I had a strong glass and examined him again and found nothing. His scales were as bright as could be; he measured two inches; his stomach was not overloaded but nice and full. I took my knife out and opened him and examined his gills, but there was nothing there and nothing in his throat. I opened him from one end to the other and I found undigested food, that he had just swallowed, and food that he had in his stomach and was digesting. I know it was not the Chicago food that caused his death, because that was not digested. What killed him I don't know. There was only one thing peculiar, and whether that was natural or not I cannot say —the food was a little bit gummy. But there were hundreds of fish right around him that ate that, and that is the first of it that I discovered. My opinion is he was caught by another fish, was too large to be eaten, got away, and died from the effects of it, but when I found no marks, I used a strong glass on him and even then I could not find anything; but I cannot blame the Chicago meat, because it would have affected the others, and I think I have got as plump a lot of fish as anyone.

Mr. Titcomb: You drew your pond in September to get those fish?

A. Yes sir.

Q. And the fish were not sorted in the meantime?

A. No sir—the water was too deep.

Q. How many did you get out of this pond?

A. Fully 100,000. I put 200,000 in, but my loss I attributed to the extra large bass that were in there.

Q. How large a pond have you?

A. I think it is about 200 by 170 feet wide.

Q. You refer to the small mouth bass?

A. Yes. I can raise more small mouth bass in the same amount of water than I can large mouth.

Q. What was the average temperature through the summer?

A. I have not kept the full temperature record; but my temperature has, in the lower pond, run up as high as 90°. In my spring pond, where we used altogether spring water, it never exceeds 60° one hundred feet from the main spring.

Q. The one you had 100,000 in?

A. That was 78° Sunday.

Q. You have a constant flow of water through that pond?

A. Not as heavy as it is here in Mill Creek.

Mr. Clark: Did you take 100,000 out towards the fall?

A. The 15th of September.

Q. Out of a pond 170 by 200?

A. Yes—it may be 250—but those fish were fed twice a day, and any quantity of insects were in there. The fish were just estimated—I had a net when I delivered to the car, and I counted that net full, and I use so many nets full to every bucket or every can that goes to the car.

I might add that we raise not only bass but catfish.

Mr. Titcomb: What kind of catfish do you cultivate?

Mr. Morcher: Marble cat. Where they get them from I don't know. They were gotten by a man that had a hatchery in Waverley. The state rented it of him for ten years. Then I took hold of the London hatchery and moved them there.

Mr. Titcomb: Have you ever tried the speckled cat?

A. No, we have tried the channel cat, but cannot keep them.

Mr. Lydell: I went to Mr. Morcher's station about this time last year and he certainly has one of the greatest propositions for bass I ever saw, though they do not ship any bass during the summer, but wait till the fall. Of course, they do not have the waters to look after that we do in Michigan; the lakes are so very scattering that a few carloads of fish take care of nearly all the inland waters, I think.

Mr. Morcher: Last year we furnished all applicants, but the year before we did not, and everybody seemed to be well pleased, except a few wanted all bass and got some catfish. Then I had plenty of them to put around in Madison county where I get my own fall and winter food.

Mr. Bassett: I would like to ask Mr. Morcher what he knows about the quality of the flesh of fish when prepared for the table, where this food, or other prepared food, is used, as compared with those fed on liver.

Mr. Morcher: I cannot say. I have had no experience in that line.

I had a misfortune last year in emptying one of my ponds. I think Mr. Lydell saw the fish. There were 170 in the pond, small mouth bass. We went there June 5th, about 6 o'clock in the evening, and I wanted to get this water on the inside of the fence, so that none of the fish would be caught with the seepage out of it during the night, and I drew from the top of the water to the bottom of the pond, six and a half feet, but left three and half feet of water in the deepest part of the pond. I also was very cautious about getting the moss, cutting out these runways to the deep water, and all around the outer edge, to prevent my bass from getting in there and getting choked up, for I had a large quantity of hatching tubs in there. Now this was in September, I think about the 20th, at the time of the first frost we had up in there. At 6 o'clock I left the pond seeping water from springs coming in from all directions, but no waters running from the upper pond, but plenty to maintain 170 fish with the amount of water they had. I went back the next morning a quarter to

seven—I did not get home till 10 o'clock, and the men were a little ahead of me. I went up to where I let the water out and found my bass piled four deep, some dead, some part dead, some just breathing yet. I called the men, and I don't know whether I lost my head, or what, but I waded into it, and began to throw them out. I just took them over to the next pond and did everything I could to revive them and I saved out of the 170, 38. After I got my pond cleaned out I put the dead fish into the ice-house and examined them. I looked down their throats and found they were plugged up with mud and moss. I opened them and found the entire stomachs were full of mud and moss. The only theory I can give for the death of those fish was that these little minnows in this pond went down into this deep water in the morning at four or five o'clock, and these old fish discovered them, and they banked these little fellows two feet out of water on the bank, and tried to get them, going after them with their mouths open, and they would catch the bank and filled themselves up with this moss and mud, for their stomachs were full of it. There was none out in the deep water; the water was not a bit roily; but there they lay all on a pile, in a row twenty feet long, and wherever I found them I found the little chubs lying up on the bank. Now if anybody can give me the reason for the death of those fish in so short a time, I would like to know it.

Dr. Birge: What became of those that you put over into the other pond.

Mr. Morcher: They were all right.

Mr. O'Brien: How many thousand do you carry on a car?

A. Seventy thousand or seventy-five thousand. We have eleven large tanks in each car. Then we generally fill a number of cans and have them in the aisle to deliver at the first station.

Mr. Titcomb: I hope Mr. Morcher will count his fish next fall. I do not believe he is carrying so many as he thinks. We carry as many as we think we can carry safely, but we cannot do any such work as that. I think the only way to settle that is to count them.

LETTER ON THE PROPAGATION OF BLACK BASS.

BY HENRY W. BEEMAN.

Success in the propagation of the small mouthed black bass, I am led to believe will be assured only by the closest attention to all the details entering into the work, and unless one is willing to devote his entire time and best energies of both mind and body to the enterprise success will not be forthcoming. We have demonstrated beyond all doubt that the fry can be brought to the advanced stage with the greatest degree of success and we are thoroughly convinced that they are as valuable for stocking purposes then as at any time. To carry large numbers of the advanced fry in small ponds and attempt to raise them to fingerlings is another proposition, although our method of feeding for fingerlings produces most vigorous fish, that actually make more rapid growth than when in the wild state; the difficulty in raising considerable numbers in small ponds is due directly to the peculiar habits and characteristics of the fish. It is natural for them when they have arrived at the advanced stage to scatter, each individual going by himself, and to crowd large numbers into small ponds will usually result in at least partial failure. Nature is quite likely to assert herself, and the fish become rapidly reduced in numbers until the size and condition of the pond in which they are confined shall be sufficient to meet their requirements. Finally our experience leads us to the conclusion that better results are secured by carrying the fry only until the advanced stage of growth is made, at which time the wily watchful and secretive habits peculiar to the bass are fully developed and if planted where sufficient cover is at hand, the greater part will survive.

It is a great disappointment not to attend the annual meeting of the American Fisheries Society. My time is so fully occupied with my duties here at the hatchery there is no time to write a paper nor to attend the meeting this year.

ASSORTING BROOD BLACK BASS TO PREVENT CANNIBALISM.

BY J. J. STRANAHAN.

Experience has taught at Cold Spring Station, Bureau of Fisheries, that there are in all our ponds individual large mouth black bass which are specially cannibalistic and it is the intention of the writer to remove all such in future as fast as discovered, even resorting to the rifle to get them when necessary. But he believes that all large mouth black bass, and presumably small mouths also, should be assorted into the ponds in as nearly the same sizes as is practicable, the large ones into the larger ponds and so on, it being desirable, where that number of ponds is available, to make them up into at least four or five grades.

The larger bass are necessarily more logy and less active in their movements and therefore unable to protect their young from the raids of the smaller and more active individuals. They are also much less prone to cannibalism, in fact it is a rare occurrence to see a bass weighing four or five pounds or more feeding on the fry in our ponds.

When the smaller fishes are by themselves all are equally active and a one-pound male will defend his brood so vigorously that even the specially voracious individual soon finds that he can not run amuck among the fry at pleasure without suffering the consequences and cannibalism is reduced to a minimum even among the smaller and more bloodthirsty classes.

Of course, a station must keep up its brood stock by either raising a supply from year to year or by introducing wild stock and by this system of sorting this growing stock can be made useful from two years old and later, while, in our opinion they would be far better kept by themselves and not reproduce at all than to place them with the larger fishes.

It has sometimes been argued that such assorting as above recommended will result in a disproportion of the sexes. We do not believe that this argument is tenable. We have observed some of our largest bass this season guarding nests and pro-

tecting broods and, while it is probably true that there is a preponderance of females among the very largest bass, this is not enough to break the force of our position as to assorting, for if perchance there should be some loss through the disproportion mentioned, it would be many times made good by the beneficial results obtained by a rigid segregation of the sizes.

There is another reason, and a strong one, for thus sorting the fish. The young and growing fish should be fed more and oftener than the large ones. Feeding of the large fishes during breeding season to prevent cannibalism is entirely unnecessary while the smaller ones, both for their healthful growth and to mitigate cannibalism during breeding time, require more frequent feeding. This change will save feed and labor but the more important feature is that of saving the adult fishes for a very large percentage of loss among our larger fishes, those which should be in their very prime for reproduction, is caused by what in the case of the human being would be called fatty degeneration, if we may judge from general appearances, the organs being covered and obscured by fat, the liver being yellow, when cut in section, from an accumulation of this material. When by themselves the larger fishes could be fed more sparingly and this loss through excess of adipose could be at least measurably lessened.

In concluding the writer would give it as his opinion that where the fishes are properly assorted as to size a larger number could be successfully carried in a given area, for one of the reasons that numbers should be restricted is that the fish interfere with each other while the parents are caring for their broods, this generally being done by the smaller adults rushing into the schools and devouring numbers of the fry, separating them and very often breaking up the schools before they would naturally segregate. Under normal conditions at this station the schools will hold together until the fry have attained a length of one inch or one and one-eighth inches but we often find broods broken up into several small schools when they are half that size and this is generally caused by the raids of the small adults. Of course, unprotected by the parent fish, these will perish unless taken out and shipped, which is our universal practice.

DISCUSSION.

Mr. Clark: The point in his paper is good, that when the bass get large, weighing four, five or six pounds, they do not begin to do the damage in a pond containing fry that yearlings do.

Mr. Meehan: Our experience has been that we have to get them in in the fall and if we put them in in the spring we cannot do a thing with them.

Mr. Lydell: One lot I put in this spring, did not do anything, and the second lot I put in in the evening and the next afternoon they spawned. We got such good results because they were so near spawning that they could not help themselves.

Mr. Meehan: It is a curious thing, because I had the experience with the small mouth bass that if we did not get them in in the fall we could not get anything out of them at all.

Mr. Clark: We had small mouth bass at Northville that spawned six or seven days after they were put in, wild fish brought from the Saginaw River.

Mr. Nevin: In regard to building bass ponds, are you building large or small?

Mr. Lydell: Ponds number three, five and one are my regular breeding ponds. The large ponds are for large mouth bass and for rearing. I had to take them and transfer them to number seven, where I left them for breeding this year.

Mr. Titcomb: How many adults did you put in number three?

A. Fifteen or eighteen pairs. I have been reducing the number of adults to the pond ever since I began propagation, and get better results all the time.

Mr. Clark: If you had just the kind of place you wanted and could do just as you wanted, would you have large ponds for rearing bass? Would you prefer half an acre, three-quarter's of an acre or ten acres?

Mr. Lydell: I do not think I would have a pond larger than 300 by 150 feet. I think for rearing exclusively, if your pond

is so you can control it and clean it out in the fall, it makes no difference whether it is 100 or 1,000 feet in diameter. I do not see that it makes any difference, only that the ponds of the sizes that we have here are very much handier than larger sizes would be. When you commence to ship you can clean that pond and ship your fish, whereas in a big pond you have got to draw the whole pond down in order to get the fish anyway, although you may not want all the fish.

Secretary Peabody: You remember Mr. Beeman told the association that he had discovered that the female bass spawned several times during the season. What is your judgment about that now?

Mr. Lydell: I never have actually seen the female bass spawn the second time. I think however that some females do spawn a second time. I know a female bass will spawn partly on one bed and go to another bed with another male and spawn there.

Mr. Titcomb: Both small and large mouth bass?

Mr. Lydell: I am speaking of the small mouth bass.

Mr. Nevin: Do you think roily water affects them?

Mr. Lydell: I think so—if it is during the spawning season.

Mr. Nevin: In the Mississippi River it is very roily, and that seems to make no difference.

Mr. Lydell: It will drift in here and settle on our beds an inch and a half deep in one night.

THE BEST PAINT FOR SCREENS.

BY MR. LYDELL.

Last year the question was asked in regard to a paint to keep screens from rusting. This season we have used here at the Mill Creek Station an article put out by the Sherwin & Williams Co., called the Sherwin & Williams Pure Atchison Graphite Paint. We have found that if fills the bill better than anything yet used. The company lent us samples (showing screens) coated with one, two and three coats. The number of coats on each screen is indicated by these small white marks on the corner (indicating); one mark, one coat, and so on. You will notice that in bending the screen up it does not break the coating.

Mr. Nevin: Do you think it is better than coal tar?

Mr. Lydell: Ten to one. You can put it on more quickly than tar.

Here is a screen with one coating on it which has been in use all summer long; it was put in a pond the first of May and taken out last week.

Mr. Bassett: What is the address of this firm?

Mr. Lydell: You can buy it at any hardware store in the United States. The cost is something like $1.50 a gallon, and the name of the paint in full is Sherwin & Williams Pure Atchison Graphite Paint.

TUBE FOR AERATING WATER.

President: One of our overseers has developed an appliance for his own use which I think is very valuable and we shall be very glad to hear Mr. Price explain his device, which consists of a tube for aerating water.

Mr. John L. Price, Drayton Plains, Mich.: This is what we have named an aerating tube for aerating water in carrying fry and advanced fry in cans. (Demonstrating apparatus.)

It is provided with four quarter circle holes operated by a valve at the top. An extra bottom is put on to keep the fry from being sucked into the inside of the tube and injured in that way. Now by raising the valve and slowly settling the tube in the can, it is filled. In lowering the tube exercise care to avoid touching the bottom of the can with the bottom of the tube. On the inside there is a guage so that when the can is filled within an inch of the top the guage shows you one inch of water between the bottom of the tube and the bottom of the can, so that there is no danger of injuring the fish.

When the tube is filled you raise your finger, raise the valve and that lets the water out. The extra bottom is fitted with a valve, and when you raise the valve above it closes that and forces the water to a circle, acts as a reducer and gives it force. This is provided with a screen and prevents the fish fry getting in there. The tube will fill in ten seconds, and empty in five, without injuring any kind of fry.

The tube holds just a gallon and three-quarters of water, and five applications of the tube practically empties a ten gallon can and it takes the water from the bottom of the can and aerates it on the surface. For carrying wall-eyed pike, shad and white-fish, we put another bottom on provided with a finer screen, and that prevents the sucking in of the fry, and you get the same results.

You can use it for a pail for a fresh supply of water, and it also takes the place of a siphon.

REPORT OF COMMITTEE ON FOREIGN RELATIONS.

BY MR. CHARLES G. ATKINS, OF EAST ORLAND, ME.

The Committee on Foreign Relations in submitting its first report begs to presume that it was not expected that a single report, or two or three reports, could cover the whole field. Indeed, it needs but a cursory examination of the exhibit of the matter made by correspondence already in hand and by accessible publications to show that it would be impossible to exhaust the subject, or even to keep fully up with the new matter of interesting and instructive character developed from year to year in foreign experience within any limits that would not swell the volume of annual transactions beyond practicable size. It has therefore appeared to your committee best to attempt no exhaustive treatment of any branch of the subject, but to endeavor to submit a series of brief summaries of the organization and system of fish cultural work in foreign countries together with a more minute treatment of such branches of the subject as may promise to be most helpful to American fish culture.

In illustration of the world-wide interest in fishery subjects may be cited the successful organization at Paris in 1900, of the system of International Fishery Congresses by the appointment of a permanent International Commission, the original composition of which embraced members from Germany, Austria, Switzerland, Italy, Spain, Portugal, France, Belgium, Holland, Denmark, Norway, Sweden, Russia, Roumania, Great Britain, Japan, the United States of America, Mexico and Chili. The most of these countries have engaged in actual fish cultural work.

The most important sources of information on this subject, outside of official reports, are perhaps the fishery periodicals of the world. A list which may not be exhaustive shows the existence of three such periodicals in France, one in Belgium, two in Switzerland, one in Austria, one in Sweden, one in Denmark, one in Finland, and six in Germany. The German periodicals alone present the reader with over 3,000 pages of fishery litera-

ture annually. And this statement does not include the reports of experiment stations or the great mass of matter appearing in sporting journals, as in the United States and Great Britain.

Of fish literature other than official and periodical we may get some idea from the list of new matter published from time to time by the Bulletin of the Central Aquicultural Society of France, which quotes in a few recent issues twenty-one titles of works pertaining strictly to fish culture; twelve titles dealing with aquarial natural history; seven titles of technological works; and fifteen titles of works dealing with fish and fishing in a general way.*

The first step taken by your committee in its inquiry into foreign fishery matters was the issue of a circular** covering the subject quite fully; and it is mainly from the information thus elicited that the statements relative to the status of fish culture in various countries have been made up.

The foreign notes herewith submitted cover work and condi-

*See detailed lists below.

**The circular of inquiry reads as follows:

Information desired by the Committee on Foreign Relations of the American Fisheries Society regarding fish cultural conditions in foreign countries.

1. Does the Government engage in the artificial culture of fish?
2. What is the name of the bureau or department having immediate charge of fish cultural matters, and how is it officered?
3. Please forward any publication in which this work is officially considered.
4. What species are artificially propagated?
5. At what ages are the various species distributed?
6. Number and location of stations for fish culture maintained by the Government?
7. How many of the above have been established within the past five years?
8. What sums exclusive of salaries of regular employes are annually expended in the artificial culture of fish?
9. What salaries are paid to officers and employes of various ranks in the fish cultural service?
10. What are the total expenses for salaries of permanent employes?
11. How many fish of each species were distributed during the last fiscal year? A table of distributions of the various species for the past four or five years would be much appreciated.
12. What have been the general results from the artificial propagation of fish?
13. What is the sentiment of the general public in regard to the value of fish culture?
14. What exotic species of fish have been introduced, and with what results?
15. Please state the number of private fish cultural establishments now in operation. Of these what number have been established within the past five years?
16. What are the principal species of fish handled at such private establishments, and what is the approximate annual output of (a) eggs, (b) fry, (c) brood fish, (d) fish for market?
17. Names and addresses of any societies or associations for the furtherance of fish culture or any other fishing interests?

tions in Canada, Peru, Chili, Argentina, New Zealand, Tasmania, England, Scotland, Holland, Sweden, Finland, Japan and China.

CANADA.

Fish breeding was conducted in Canada, previous to 1868, on a very limited scale as a private enterprise; but during the year above mentioned the work was taken over by the Federal Government. From one hatchery this work has been extended as circumstances would permit until today there are thirty-two fish breeding establishments in operation throughout the Dominion. Those erected of late years are of modern structure and are equipped with the latest appliances.

The Federal Department of Marine and Fisheries has control of all public fish breeding establishments in Canada. The work connected with the Fish Culture Branch is supervised and conducted by the Superintendent of Fish Culture, subject to the approval of the heads of the department at Ottawa. The branch is officered by the Superintendent of Fish Culture, Secretary, and Inspector of Hatcheries, located at Ottawa, and the permanent officers-in-charge of hatcheries residing in or near the establishment under their supervision.

The work up to about three years ago was devoted entirely to the hatching of the commercial species but public demands for the sporting varieties became so strong that operations to a limited extent were begun in this direction. The species now operated with are as follows: Pacific salmon, Atlantic salmon, salmon trout, grey trout, lake whitefish, pickerel, speckled trout, ouananiche, small-mouthed black bass, shad. In addition lobsters are incubated in several establishments on the Atlantic coast.

Until recently the various species have been distributed in the fry stage. Three years ago a rearing pond for Atlantic salmon was constructed in connection with the hatchery on the Restigouche River in New Brunswick in which the fry is retained until they are about six months old. This system has been very successful, but, owing to the heavy expenditure and the difficulty of securing suitable locations for rearing ponds, this branch of the work is being cautiously extended as occasion offers.

There are thirty-two establishments throughout the Domin-

ion maintained by the Federal Government and located as follows:

Province of Ontario: Ottawa, Sandwich, New Castle and Belleville.

Province of Quebec: Tadoussac, Gaspe, Magog, Lac Tremblant, St. Alexis and Lake Lester.

Province of Nova Scotia: Bedford, Margaree, Windsor, Bay View, Canso and Forchu Lobster Pond.

Province of New Brunswick: Restigouche, Miramichi, St. John River, Shippegan, Shemogue and Carleton Pond.

Province of Prince Edward Island: Charlottetown and Kelly's Pond.

Province of Manitoba: Selkirk and Berens River.

Province of British Columbia: Fraser River, Skeena River, Granite Creek, Harrison Lake, Rivers Inlet and Pemberton.

Twelve establishments have been put in operation in Canada during the past five years.

The sum of one hundred and twenty-six thousand dollars is spent annually in the artificial culture of fish. The Superintendent of Fish Culture for Canada receives two thousand two hundred dollars per annum. The Inspector of Fish Hatcheries, one thousand and two hundred dollars per annum. The officers in charge of hatcheries are paid in accordance with the importance and responsibilities of the several stations and the salaries range from five hundred to one thousand two hundred dollars per annum. The assistants are paid from one dollar and fifty cents to two dollars per day according to the nature of the work performed. The salaries of permanent officers amount to about twenty-four thousand dollars per annum.

The attached statement gives the numbers of each species distributed during the past four years.

It is generally appreciated that the money expended by the Canadian Government in the propagation of fish has been well spent and the returns to the public, both from a commercial and a sporting standpoint, have been eminently satisfactory. Fish Culture in Canada meets with public favor From all parts of the Dominion applications for the extension of this service are continuous. No better evidence of popular opinion is required than a comparison of the amount appropriated by Parliament for

Fish Culture, which in 1895-96 was forty thousand dollars. This amount has been gradually increased from year to year until in 1905-06 the grant is one hundred and fifty thousand dollars.

No exotic species of fish have been introduced into Canadian waters, operations being confined to indigenous species.

STATEMENT OF THE NUMBER OF FRY DISTRIBUTED IN CANADIAN WATERS DURING FOUR YEARS, 1902 TO 1905.

	1902	1903	1904	1905
Atlantic salmon...	9,857,000	7,348,000	8,373,500	9,114,000
Pacific salmon.....	15,974,000	17,818,000	13,560,000	16,772,000
Whitefish	108,000,000	81,000,000	82,500,000	105,500,000
Pickerel	15,000,000	21,000,000	24,000,000	26,000,000
Salmon trout.....	2,460,000	4,618,000	2,575,000	3,530,000
Speckled trout....	10,000	65,000	16,000	514,000
Rainbow trout....	.....	71,500	98,000	50,000
Grey trout.....	.....	.....	.....	260,000
Lobsters	120,000,000	181,000,000	337,000,000	463,000,000

The government of Peru has contracted with Mr. R. E. Coker, a graduate of Johns Hopkins University and a former employe of the Bureau of Fisheries, to conduct biological observations along the coast with the view of investigating not only the marine fisheries but the guano industry and make recommendations as to the advisability of changes in the laws for the protection of fish and the protection of guano-producing birds. The purpose of the investigation is not only to increase the supply of commercial fishes but also to take measures to protect the food upon which the guano-producing birds live. Mr. Coker will also make investigations with the view to the introduction of oysters.

Some inquiries have been made with reference to investigations in the fresh waters of the country. Although under tropical skies the fresh water streams and lakes of Peru are fed by glacial waters, and many of them are at an elevation where the climate is temperate rather than tropical. Lake Titicaca in Peru and Bolivia is the highest navigable lake in the world and its waters are undoubtedly cold enough for the introduction of some desirable fresh water species of fish from the temperate zone. It is of interest to know that the present inhabitants of this lake, at an elevation of about 12,000 feet, are all of marine origin. There are many lakes including the headwaters of the

Amazon of which the impression has prevailed in Peru that the waters are too cold for fish life. Some of these would undoubtedly prove congenial to some of the species of Salmonidae.

CHILI.

Attempts at fish cultural work in Chili have been conducted for a number of years under the direction of Frederico Albert, Chief of the Seccion de Aguas i Bosques del Ministerio de Industrias. It appears that on two or three different occasions previous to the administration of Mr. Albert the Chilian government obtained shipments of salmon eggs without making preparation for their reception in the country. Consequently when the eggs arrived in Chili after a long journey they were a total loss

Carp were introduced into Chili a number of years ago with disastrous results. Mr. Albert reports that after they were introduced the trucha and pejerrey which abounded in the streams of Chili became very much diminshed in numbers. He attributes the diminution to the fact that the carp devoured the food upon which the native species subsisted, and states that the carp themselves were not a success and that they became a thin and bony race of fishes. His report indicates that the species acquired more bones than the usual number, but it is inferred that this is not the case. The bones became more prominent as the fish became reduced in size and flesh. In addition to the carp, tench, calico bass, and goldfish were introduced but no information has been received as to what effect, if any, was produced by their introduction.

During the year 1903 quite an extensive salmon station was constructed near Los Andes During the past year 300,000 fishes six months of age were distributed from this station, consisting of Atlantic salmon, rainbow trout, brown trout, and steelhead trout, the eggs of which were all obtained in Europe. It is too early to report any results from fish cultural work in Chili, however. While the people in general can not yet appreciate the value of fish culture, it is regarded as of great importance by the government. There are no private fish cultural establishments in the country.

ARGENTINA.

As the Society has already been advised, this work was inaugurated by the Argentine government in the fall of 1903, when Mr. John W. Titcomb was employed to make investigations. Mr. Titcomb was in the country seven months during which time he traversed portions of it lying between latitude 25 degress and 42 degrees south. He constructed the first hatchery in South America and before leaving Argentina, eggs of various species of Salmonidae had arrived and had been successfully hatched. The government has organized a division of fish culutre in the Bureau of Animal Industry of the Department of Agriculuture, for the support of which $35,000 paper money ($15,418.50 gold) is annually appropriated for salaries. The chief of the division of fish culture is Mr. E. A. Tulian, a member of this Society and formerly superintendent of the United States Bureau of Fisheries Station at Leadville, Colorado. The government provides for a second chief and the necessary number of superintendents of stations. At the present time, besides Mr. Tulian three fish culturists from the United States have entered the employ of the Argentine government. The following list shows the assignments of eggs furnished the Argentine government from the United States and the results secured from them.

Year	Species	No. Shipped	Per Cent. Hatched
1904—	Brook trout	103,000	82
	Lake trout	50,000	95
	Rainbow trout	§100,000	..
	Steelhead trout	*20,000	..
	Landlocked salmon	50,000	90
	Whitefish	1,000,000	90
1905—	Brook trout	300,000	94
	Lake trout	224,000	95
	Rainbow trout	100,000	48
	Landlocked salmon	30,000	83
	Chinook salmon	†100,000	..
1906—	Brook trout	60,000	79
	Lake trout	80,000	94
	Rainbow trout	24,000	10
	Landlocked salmon	20,000	93
	Chinook salmon	300,000	97
	Sockeye salmon	122,500	95
	Silver salmon	89,180	97

It will be noticed from the table that the eggs of the rainbow

§Planted eggs in Laguna la Grande en route to Nahuel Huapi.
*Hatched en route and planted from the vessel off the Brazilian coast.
†Eggs a total loss.

trout in 1904 were planted en route to the hatchery. This was due to the fact that they were in bad condition and it is very doubtful if any of them produced results in the waters where planted. In 1905 only 48 per cent. of the eggs hatched, and in 1906 only 10 per cent. The cause of this low percentage is not postively known but in all probability it was due to the fact that the eggs were taken from fish which were reared in spring water and the eggs were eyed in water of a temperature of about 53 degrees. They were then subjected to a temperature of 34 to 35 degrees for a long period—a necessary proceeding where they are to be carried in transportation cases on a trip from forty to fifty days in duration. Whether rainbow trout eggs taken from wild fish can be eyed successfully in an extremely low temperature and then transported with good results is yet to be determined by actual trial. Certainly it is known that rainbow trout eggs are more sensitive to temperature changes than any of the other species of Salmonidae artificially propagated.

The eggs of the steelhead trout which proved a failure in 1904 were undoubtedly too far advanced for shipment. The loss of the chinook salmon eggs in 1905 is not accounted for. They were packed by an expert who has successfully carried eggs of this species to New Zealand with very small losses, and the question of temperature or the stage at which packed are not factors to be considered unless the temperature of the eggs became too low while they were being held in cold storage in England or in Buenos Aires, in each of which places they were so held for several days. Eggs of other species shipped at the same time were held in a similar manner, however.

In addition to the eggs secured from the United States 25,000 Atlantic salmon eggs and 5,000 brown trout eggs were obtained in England during the past year. Hatcheries have been established at Nahuel Huapi, Santa Cruz, Alta Gracia, Buenos Aires and Chascomus. Eggs have already been taken from the brood stock of trout reared from the first lot of brook trout eggs sent to the country in the winter of 1903-04 and hatched and reared at Nahuel Huapi.

In addition to the acclimatization of foreign species of fish one native fish is propagated, namely, the pejerrey. There are two species of pejerrey in Argentina, *Basilichthys bonariesis* and

Basilichthys microlepidotus. They are regarded as the most valuable fresh-water fishes of the country. They are found in fresh, brackish, and salt water. During the winter months one species at least *(Basilichthys bonariensis)* ascends the Rio de la Plata from salt or brackish waters to places above Buenos Aires where it is caught by anglers with two or three hooks attached to one line, very much as the smelt is caught in the tidal rivers of New England However, there is never any ice in the Rio de la Plata. The fish is a spring spawner, ripe spawning specimens having been found from early October to late November according to the altitude or latitude and consequent temperature of the water in which caught. The fish has very clear white flesh and small specimens are almost transparent. When from five to eight inches long pejerreyes are served in English and American cafes in Buenos Aires as smelt.

I have seen adult specimens weighing five or six pounds but I understand they sometimes attain a weight of fifteen pounds. The fish has quite an extensive range in the country but the people are now stocking some of the uninhabited lakes with them, thus extending the range by artificial propagation. The eggs are adhesive and in some instances it has been found best to transport the eggs direct to the waters to be stocked and plant them in the lakes where they are surrounded by brush or other proper protection from predaceous birds and animals until they hatch. The eggs have also been hatched to a limited extent in McDonald jars.

There are no private fish cultural establishments in the country.

In addition to the work with fishes a practical oysterman has been employed by the government. He recently arrived in the country with a lot of oysters to be planted at suitable points along the coast. He is to remain in Argentina for an indefinite period and make investigations as to the possibilities for extending the work of oyster culture.

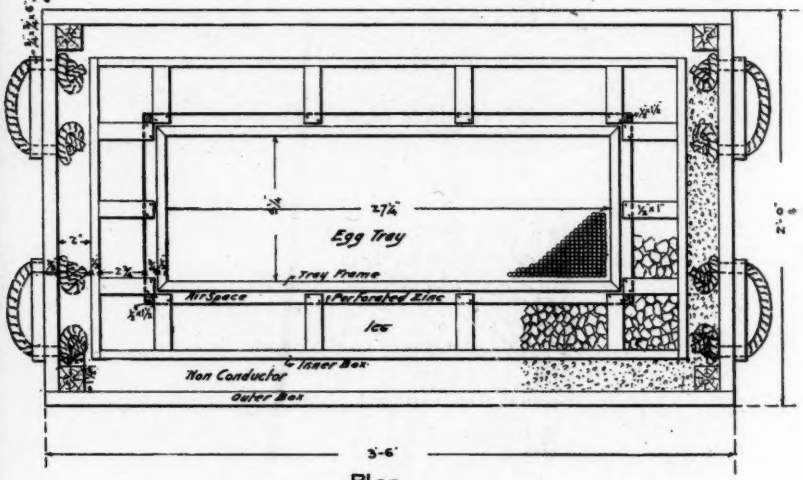
With each shipment of eggs from the United States to Argentina some minor improvements have been made. The following is a description of the case with improvements last adopted:

The case consists of an outer and an inner box, having a space between them filled with non-conducting material, an ice space,

Dept. of Commerce & Labor
Bureau of Fisheries

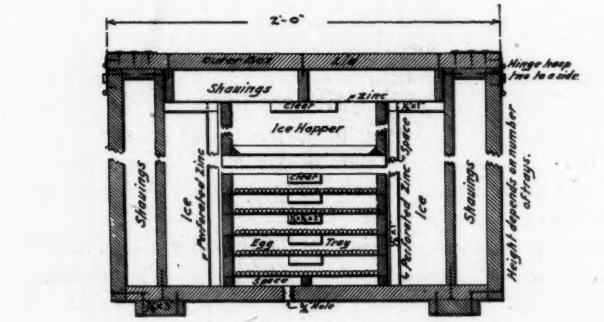
Argentine Egg Shipping Case.

1906.



Plan.

Scale.



Section.

and egg trays in the center, with a lid on top. The bottom of the outer and inner box is common to both. Tongued and grooved lumber should be used in the construction of the case.

The height of the case is based upon the number of trays required to carry the proposed shipment, though one or two empty trays are not objectionable. The case should be 3 feet, 6 inches long, 2 feet wide, and not to exceed 30 inches high, outside measure. Four hasps are used, two on each side of the lid, so that it can be opened from either side. Rope handles are placed on each end of each case, with a cleat of three-fourths inch material placed close above the holes for each rope handle.

Between the inner and outer box there is a two-inch space on all sides which is to be filled with a non-conducting substance such as shavings, moss or other suitable material, and covered as shown on blue-print. A similar space and non-conductor having a metal covering and fitting neatly over the ice hopper and space for ice should be attached to the lid of the outer box. It is important that the inner box be made water tight in order to keep the filling dry.

Between the inner box and the egg trays there should be a two and three-fourths inch space for ice, separated from the trays by perforated zinc, and between the perforated zinc and the trays a space of about three-fourths inch. The one-half by one inch and one-half by one and one-half inch vertical supports for the perforated zinc are to be placed between the perforated zinc and the trays. These supports are held in position by short strips of the same material fastened on top.

The ice hopper is made of thin material and covered on the bottom with perforated zinc. Cleats or small rope handles should be attached to the ice hopper which is made removable but so fitted as to secure it against sliding.

The tray frames are made of one-half by one and one-fourth inch lumber, and it is important that they fit easily in the center of the case. The bottom is to be covered with wire cloth of No. 25 or 27 wre, about twelve meshes to the inch, which is stretched tightly so that it will not sag, causing the drip water to settle in the middle of the trays to the detriment of the eggs near the edges. It is desirable to have a covering of strong cloth over the edges of the wire bottoms of each tray to prevent their sticking

to the mosquito netting of the tray underneath. A short one-half inch lifting cleat is fastened to the inside ends of each tray. Wedges are used to keep the trays in place. The bottom tray rests on three small cleats fastened to the bottom of the case length-wise as shown in blue-print, and having small "V"-shaped grooves cut into them for the passage of drip water to the drain hole.

One three-fourths inch drain hole, provided with a cork, should be made in the bottom of the case as shown in blue-print. Two seven-eights by three inch cleats are placed lengthwise under the bottom of case. The inner box, bottom of lid, hopper, trays, perforated zinc, and supports are asphalted.

It is important that the outside dimensions of all tray frames be uniform that the trays may be interchangeable.

The eggs selected for shipping should barely show the eye spots without the use of a glass, and should be picked over very carefully. In packing, spread a layer of moss as evenly as possible over the tray bottom to a depth of one-half inch and upon the moss place a layer of mosquito netting. This prevents the eggs from mixing with the moss and working through it to the tray bottom. The eggs are laid upon the mosquito netting one to two layers deep, spread to within one-half inch of the tray frame, and covered with another piece of netting. The remainder of the tray is then to be lightly filled with moss. The upper netting should be cut large enough to extend up to the outer edge of the tray all around, so that in examining the eggs it can be rolled back and returned without disturbing the eggs.

The cases of eggs are usually stored in one of the fruit rooms to which the attendant has access daily. It is customary to wet down the eggs with ice water daily and pick them over whenever necessary. The water should be of the same temperature as the eggs, thirty-four degrees to thirty-five degrees and is poured through the hopper. The ice compartments are kept full of ice by replenishing daily or as frequently as necessary. There are, as a matter of course, occasional days when the attendant cannot have access to the fruit room.

NEW ZEALAND.*

When the Britons first settled in New Zealand they found beautiful clear water streams fed from snow-clad mountains which contained very few and inferior fresh water fishes. Acclimation societies were formed and through them shipments of eggs of various species of Salmonidae were imported with varying success.

The brown trout was introduced in New Zealand about thirty years ago. The first shipment was from England to Tasmania and from eggs obtained at Tasmania the stock was obtained for New Zealand waters. Later shipments of brown trout eggs were sent direct from England to New Zealand. With the exception of the Auckland district, brown trout have been put into almost every stream in the south and as a result there is excellent brown trout fishing in almost every district. Within certain distances of the sea in all east coast rivers brown trout have become anadromous, going down to the sea after spawning and living there all summer, returning in the autumn. These fish are frequently taken by fishermen in nets when fishing for indigenous marine fishes. The fishermen say that they are caught in from five to seven fathoms of water. In handling them for stripping they have run from five to twenty-two pounds in weight. They are very much esteemed by the sportsmen. They take the fly readily but not more so than the steelhead trout; in the lower regions they are taken by casting the ordinary spinner. Brown trout are also found in lakes of the south. Records show the weight of the lake trout to be twenty-seven pounds.

Several importations of Loch Leven trout eggs direct from the hatchery of Sir James Gibson, Howieton, Scotland, have been made. The fish hatched from these eggs were held as brood stock in the ponds of the various acclimatization societies, and the young fish from the brood stock thus obtained were liberated in the streams—sometimes in the same rivers with brown trout. Commissioner Ayson states that where the Loch Leven trout has been introduced into the same stream with the brown trout it has been impossible to note any difference in the two species. A few Scotch sea trout have been introduced into New Zealand and

*The Committee is indebted to Mr. L. F. Ayson, Fish Commissioner of New Zealand, for most of the information following.

the opinion prevails that the sea trout, *S. trutta* is the sea run *S. fario.*

About twenty years ago the speckled trout, *S. fontinalis,* was introduced and nearly all of the acclimatization societies in New Zealand hold a brood stock of them in their ponds. In only two streams of New Zealand has this species obtained a foothold—one in Auckland district, about fifteen miles from Rotarori and one in the Canterbury district. Brook trout have been caught with rod and line up to six pounds in weight. The failure of this species to become firmly established throughout New Zealand is attributed to the presence of the brown trout.

About twenty-five years ago the Auckland Acclimatization Society was presented with a shipment of steelhead trout eggs from California by the late Thomas Russell. It is reported that this is the only shipment of eggs of the species which has ever been sent to New Zealand from the United States. The eggs were obtained from Mr. A. V. Lamotte, who had a private fish hatchery at Glenn Ellen, California, and were secured from steelhead trout taken in Sonoma Creek. They were shipped under the name of rainbow trout eggs and to this day the fish is called rainbow trout in New Zealand. The fish hatched from these eggs were liberated in streams flowing into Lakes Rotorua and Rotoiti, and other streams in the Waikato district. They have done remarkably well throughout the whole of the Aukland province, and lakes and streams in which brown trout existed previous to the introduction of the steelhead trout now have nothing in them but the latter. They seem to have superseded the brown trout. The Auckland district is the only part of New Zealand in which the steelhead trout have done remarkably well. The records show that steelhead trout have been taken up to twenty-five pounds in weight, and fish ranging from ten to eighteen pounds are not an uncommon occurrence. The larger fish are taken by trolling. The fish generally taken with the fly range from two to seven pounds in weight. Thus far there has been no evidence that the fish have become anadromous.

While the steelhead trout seem to have superseded the brown trout in the streams and lakes of the Waikato district, the many attempts to introduce them in the waters of the Wellington district seem to have resulted in failure, due to the presence of the

brown trout. Apparently the waters in which the steelhead trout survive the brown trout have a somewhat higher temperature than the waters in which the brown trout superseded the steelheads. The highest summer temperature in the snow-fed rivers in the south island is about fifty-five degrees. This is where the brown trout do not allow the steelheads to obtain a foothold.

No definite results have followed the attempts to introduce the chinook salmon previous to the year 1900. At this time the New Zealand government took up the introduction of this species in a systematic way and since then has devoted its efforts to one river, namely, the Waitaki. This river has its source in three tributary streams which flow into lakes and the outflow from these lakes form the Waitaki, which is a stream about the size of the Sacramento River in California. Chinook salmon eggs have been imported annually since 1900 and a good percentage of them have been successfully hatched. Some of the young fish have been held until over a year old before being planted. During the autums of 1904 and 1905 (month of April), reports came from the streams flowing into Lake Ohau that fish resembling salmon were spawning. The information was not received at headquarters until six weeks after the time the spawning was observed, and when a man sent out by the government to investigate had arrived, the fish had disappeared. Fishermen have stated that fish caught at the mouth of one of the tributary streams during the last two years are brown trout. However, two of these anglers, of large experience in fishing for salmon in Norway, are emphatic in their statements that they caught salmon.

There have been a great many importations of Atlantic salmon eggs, all obtained from England. The introduction of the Atlantic salmon was begun thirty years ago. In 1898 two specimens, twelve and sixteen pounds in weight, were caught by anglers and forwarded to Dr. Gunter of the British Museum, who on examination pronounced them to be *S. salar*. For the present, however, the attempts to acclimatize the Atlantic salmon have been discontinued.

Several shipments of whitefish eggs had been made to New Zealand previous to 1903 and upon arriving in the country there was no conveniience for hatching them. They were divided up

into lots and turned over to the acclimatization societies, and it is presumed that very few if any fish were successfully planted. In 1903 the New Zealand government established two small whitefish stations on Lakes Kaneri and Tekapo, and shipments of whitefish eggs have been received annually, beginning in 1903, and a large percentage of them have been hatched and planted.

English perch have been introduced in some of the New Zealand streams where they have obtained a foothold and depleted the brown trout. They also follow up the spawning trout and devour their spawn. These perch when caught sometimes weigh four pounds. English tench have been introduced into shallow water lagoons not suitable for trout.

Great credit is due to the acclimatization societies for the work done by them, but it is unfortunate that the government did not assume control of the work in the start and conduct it systematically. The presence of the brown trout in the large portion of the waters of the country makes it impracticable to introduce some of the other finer, more desirable species. The acclimatization societies were originally founded from motives of public spirit but at the present time most of them are established on a commercial basis. They control the waters which they stock with fish and the anglers pay for the privilege of fishing in these waters. A whole season's license is $5 and a half season's $3. Visitors can take out a license for a day or two at the rate of 50 cents per day.

For a description of New Zealand waters and other particulars of interest to anglers reference is made to Hamilton's Trout Fishing and Sport in Maoriland.

TASMANIA.

The fisheries act of 1889 provides for the appointment of commissioners of fisheries, not exceeding twenty-five persons, in whom are vested the general superintendence, management and protection of all the fisheries in the State of Tasmania. Various species of the Salmonidae have been introduced, namely, *S. fario, S. trutta, S. fontinalis, S. levenensis, S. irideus,* chinook salmon *(Oncorhynchus tschawytscha),* and blueback salmon *(Oncorhynchus nerka);* two indigenous species—the fresh water herring or cucumber fish, *Prototroctes maraena,* and the fresh water black-

fish, *Gadopsis marmoratus*—have been propagated, and three of the family *Cyprinidae*—European carp *(Carassius vulgaris)*, goldfish *(C. auratus)* and English tench *(Tinca vulgaris)*, have become well established in Tasmanian waters.

Until recently the young fish were distributed as soon as the umbilical sac was absorbed and the fry began feeding, but lately it has been decided to distribute the fish as yearlings The commissioners have two hatcheries, one at Hobart and the other at Launceston The government makes no appropriation, the hatcheries being supported by receipts from the sale of licenses and the sale of fish ova to neighboring states. The hatchery near Hobart was established in 1864 and the one at Launceston within the past five years As funds are limited, very little money is spent in the artificial propagation of fish. During the year 1902, eggs to the number of about 600,000 blueback salmon, and about 300,000 rainbow trout, brown trout, Loch Leven trout, brook trout, and Scotch sea trout were hatched and distributed. During the year 1905 the output of the hatcheries consisted of about 300,000 rainbow, brown, Loch Leven, brook and Scotch sea trout. The general results from all of the above named exotic species with the exception of the blueback and chinook salmon have been successful. Brown trout have been captured by rod weighing up to twenty-nine pounds, and rainbow trout in some of the waters have attained in one year and ten months a weight of four and one-half pounds.

The sentiment of the general public has been on the whole favorable to the introduction of the Salmonidae, and from a tourist point of view it has attracted annually large numbers of anglers, not only from Australia, but also from England and India. There are no private fish hatcheries in the country.

ENGLAND.*

The government of England does not engage in fish culture, but the Board of Agriculture and Fisheries maintains an observant attitude toward the subject and exercises authority in respect to many matters, such as the enforcement of the fishery laws, the

*For the facts herein stated we are largely indebted to the Hon. Charles E. Freyer, Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, London.

collection of statistics, the construction of fishways, termed "salmon ladders" and "fish passes," and the issuance of fishing licenses; and acts as the adviser of the government in fishery matters generally, both fresh water and marine.

There are, however, numerous private fish culutral establishments, including two devoted to marine fishes. Of parties engaged in fresh water fish culture we have a list of thirty-three. Of these, twenty-nine are found advertising in a few numbers of three English journals in 1906; twenty-eight of them state what classes of fish they breed or handle, and twenty-five specify the species. We find that amongst these advertisers, eighteen mention the European brown trout *(Salmo fario)*; thirteen the Loch Leven trout; twenty-one the rainbow trout *(Salmon irideus)*; three the American brook trout *(Salvelinus fontinalis)*; and one party the steelhead trout. Of fishes of other families there are four offers of perch, two of roach, and one of bream, and from other sources we are able to add to this list of coarse fish for sale, carp and tench.

Some of the establishments, we are informed by our correspondent, also handle the Atlantic salmon *(S. salar)* and the grayling *(Thymallus vulgaris)*. The Atlantic salmon would appear to be the special object of the work in the River Eden Salmon Hatchery at Carisle.

As stated above, the American brook trout *(S. fontinalis)* and the rainbow trout *(S. Irideus)* are among the species regularly propagated by many fish cultural establishments, but the prospect of their becoming acclimated is not regarded as favorable. The brook trout is reported as having almost entirely disappeared from the open waters where introduced, and the rainbow, though thriving well under certain conditions, is apt to disappear entirely from waters where it is not strictly enclosed.

The acclimatizaton of the steelhead *(Salmo Gairdneri)* has also been tried; and an attempt is now being made to introduce the Salmo Hucho from Austria.

In the marine hatcheries the species thus far propagated artificially are three species of flat-fishes, the sole *(Solea vulgaris)*; the flounder *(Pleuronectes flesus)*; and the plaice *(P. platessa)*; and among crustacea the European lobster *(Homarus vulgaris)*.

So far, then, as our information goes, it indicates a restriction to salmonoid culture more close, even, than is the case in America. Most of the advertisers offer fish one and two years old, many of them eggs; and there are many offers of live food materials and water plants.

It does not appear that the practice of growing any species of fish for market has yet established itself in England, and the use which seems to be anticipated by fish culturists of their products is the stocking of open waters for the purpose of angling, in which field Englishmen lead the world.

In angling, however, and in the use of the booty thus secured there is by no means the same limitation in species as we observe in the matter of artificial culture. The so-called "coarse" fishes (a term including all species except salmon and trout) are highly esteemed as objects of pursuit and material for food. Not only perch and pike, but the members of the Cyprinoid family, carp, tench, bream, roach, chub, etc., are thought proper objects for the exercise of the sportsman's skill. They are protected by the law, which provides an annual close-time, from March 15 to June 15, for all fresh water fish other than pollan, trout, char and eels; and the sporting journals overflow with notes of their capture, of which the successful anglers appear to be very proud. The conditions in English waters appear to be exceedingly favorable to the growth of fish and most species reach a larger size than is common with the corresponding species in America. The universal practice of weighing captures and reporting them affords a wealth of evidence in this matter. Among the numerous reports in the Fishing Gazette of London, we have lately observed, for instance, the recorded capture of chubs weighing from four pounds to seven pounds, fourteen ounces; tench weighing six pounds; bream of nine and one-half to eleven and one-half pounds; barbel of two and one-half or four and one-half pounds for small, and twelve or twelve and one-half for large; roach of three pounds, three ounces; carp of thirteen pounds, twelve ounces; and pike of thirty-six and one-half pounds.

The most important fresh water fishery of England and Wales is undoubtedly the salmon fishery There are about thirty rivers in which salmon are now caught. No complete statistics of the catch have been published, but reports from eighteen rivers

give a total of 61,474 salmon caught in 1904; and the total for the country is somewhere above that number. This is within the limits of a country having an area of 58,310 square miles, that is, about as extensive as the state of Michigan, and inhabited by 29,000,000 people. The sale of English and Welsh salmon at the great Billingsgate Market in London, which is believed to correspond roughly with the catch, declined in amount from 1895 to 1900, and after that rose in amount, the quantity passing through the market in 1904 being the greatest for ten years.

The decline which culminated in 1900 appeared so alarming as to call for investigation, and a royal commission was appointed for that purpose, having jurisdiction in Scotland as well as England and Wales After a very thorough inquiry that commission reported in 1902, and made recommendations embracing the enlargement of governmental authority over these fisheries, better regulation of fishing and more thorough enforcement of the laws governing the fishing, and measures to prevent pollution of the rivers, and obstructions to the ascent of salmon; and to secure a better maintenance of the volumes of rivers. With reference to artificial hatching they expressed the opinion that the case for it had not yet been sufficiently established to warrant their recommending the expenditure of public money on the establishment of hatcheries for supplying ova or young fish to the rivers of Great Britain generally, but that the subject was one of great importance and deserving much more careful study than it had yet received. They further advised the institution of systematic study, by observation and experiment, of the value of artificial hatching and of various problems connected with the life-history of salmon.

There exists in England an extraordinary number of fishery societies. A list, which may not be complete, shows fifty such organizations in active life in the early part of 1906. By far the greater part of them are associations of anglers, as the names indicate, and competitive and convivial purposes are prominent in their programmes, but some of them are organized for soberer purposes, such as the maintenance and enforcement of protective laws, the conduct of hatcheries, etc.

SCOTLAND.*

In Scotland the government is represented by the "Fishery Board for Scotland," which has about the same relation to Scottish fisheries as the Board of Agriculture and Fisheries has to the fisheries of England.

The board has established a hatchery for marine fishes at Aberdeen, where it also conducts sundry scientific investigations. The species bred are plaice, lemon sole, turbot, cod and some other kinds. Plaice is the leading species and 39,600,000 of these were hatched in 1904.

Fresh water species are not included in the work of the Fishery Board, but local boards and private parties engage in this work at some twenty stations. The most of them are salmon hatcheries, a few of them handling sea trout along with salmon; and two or three being commercial hatcheries dealing only with trout. At the fourteen salmon hatcheries operated in 1900 there were hatched about 3,565,000 eggs; at seventeen such establishments in 1904, the number of eggs handled was about 4,750,000 —of which probably 4,000,000 or a little more were hatched. The number of salmon fry reared in 1900 is stated at 185,000 for the whole of Scotland, and there is no evidence that more has been done in more recent years. It will be noted that for a country having eighty-one salmon rivers, the artificial work is on a small scale. It is indeed almost insignificant when compared with the vast numbers of eggs deposited by the salmon in the rivers in the natural way. In illustration may be cited the number spawning in the river Spey as observed by the bailiffs, whose duty it has been for many years, beginning in 1887, to count the number of spawning beds seen, the term "bed" being doubtless equivalent to "nest" and including only the deposit of one pair of fish. The number thus counted has ranged from 2,763 in 1890 to 7,658 in 1902, and must indicate the laying of twenty-five millions to seventy millions of eggs in a single year in that river.

There are no statistics showing the total product of the salmon fisheries of Scotland, but the Billingsgate Market in London receives great quantities of them, the receipts for the year 1904

*For data about Scotch fishery matters we are indebted to W. L. Calderwood, Esq., Inspector of Salmon Fisheries, Edinburgh.

being 14,753 boxes of one hundred pounds each, or upwards of 120,000 salmon. The great production indicated by these figures must be regarded as resulting almost wholly from the natural breeding of the salmon.

Among the trout-breeding establishments of Scotland is the famous one at Howietoun, near Stirling. Founded in 1873 by the late Sir James R. G. Maitland, it has been from the first, as now, the leading fish cultural establishment of Great Britain. It now offers for sale four species, the common European brown trout, the Loch Leven, the American brook trout and the rainbow trout, at these rates per thousand: for ova, $2.40 for brown trout and Loch Levens, $3.60 for American brook trout and $4.80 for rainbows; for yearlings prices ranging for the different species from $72 to $84. Two-year olds are to be had at $24 to $26.40 per hundred. These prices, which are doubtless about the same as those of other breeders, include transportation to any railway station in England, Wales or Scotland. The demand for these fish seems to be for the stocking of sporting waters.

The success of the introduction of the two American species is regarded by the best authorities as still uncertain.

NETHERLANDS.

Prof. P. P. C. Hoek, scientific adviser of the Dutch government in fishery matters, has communicated interesting information regarding the Rhine salmon and its cultivation and other fish cultural subjects.

The Dutch government engages in the artificial propagation of fish only indirectly and then only with reference to the salmon. Holland has only estuaries and a small part of the lower courses of the large rivers, whose sources are in other countries. There are no trouts, except a few rainbow and brown trouts reared in a private establishment and destined for restaurants in Amsterdam; there are no whitefish, except a migratory species *(Coregonus oxyrhynchus)*; there are no grayling. Of late the culture of carps and tenches has received the attention of some societies and private persons engaged in the fish trade.

With regard to salmon culture it may be noted that the Dutch government expends $3,600 to $4,800 annually in the purchase of salmon fry from hatcheries at the headwaters of the Rhine in

Germany, the release of the fry being superintended by an official representative. The fish are liberated in April when the yolk-sac is entirely absorbed, which is about six weeks after hatching. The number of such fry planted during the past six years was as follows:

1900	1,750,800
1901	1,959,200
1902	1,868,000
1903	1,532,500
1904	1,882,000
1905	2,417,500

These plants are in addition to large numbers hatched and released at the expense of Germany and Switzerland; in the former country this work has been carried on for at least thirty years.

Although only a comparatively short section of the Rhine is in Holland, the salmon fishery there is much more extensive than elsewhere. The run of salmon in the Rhine has greatly decreased in recent years, and all the countries concerned are very desirous of restoring the supply. Prof. Hoek states that it looks as if artificial propagation has done no good, but that nobody knows how bad the fishing would have become if no artificial measures had been instituted. The general public has no sentiment whatever in regard to the value of fish culture. The salmon fishermen are divided into two parties, the one thinking it is useless, the other thinking it would do good if practised on a much larger scale.

Prof. Hoek writes as follows regarding the habits of the Rhine salmon, which is of the same species as our Atlantic salmon:

You write: "The newly-hatched Atlantic salmon remain in the river for two years," and I found for the Rhine salmon that the majority remain in the river for one year only. They pass through Holland in the course of May. A part of them, however, remain longer; they are nearly all male fishes and are ripe in their second winter. What is very curious is that we never observed them wandering through Holland; I feel inclined to admit that these fishes do not grow old and have given up the seaward migration. But this is for the present an hypothesis only.

But a fact is that I have seen a great number of young salmon caught in May in Holland, and I am sure that they are fishes of thirteen to fourteen months only. I studied and described these fishes at some length and I would very much like to know how it has been ascertained that all the young Atlantic salmon remain in the American east coast rivers for two years"

SWEDEN.*

The Swedish government prosecutes fish cultural work through the Agricultural Societies, which receive subventions from the state for this work. At the head of these societies is the Royal Board of Agriculture. The Inspector of Fisheries is a member of the board and reports to it.

Artificial work is applied to the propagation of Atlantic salmon (Salmo salar); landlocked salmon; lake trout (Salmo trutta lacustris); sea trout (Salmo trutta); charr (Salmo salvelinus); whitefish (various species of Coregonus). The fish produced are mostly liberated as fry. There are in all forty-two hatcheries, of which the majority receive subventions from the state. In the year 1904 the agricultural societies paid out for fish culture 25,158 crowns ($6,793) and 600 crowns ($162) were expended on an establishment at Finspong, which belongs to the state and defrays its expenses in part by the sale of eggs and fry.

The total number of eggs handled in the different hatcheries in the year 1904 was as follows:

Atlantic salmon	2,117,000
Landlocked salmon	728,000
Trout (Salmo trutta)	535,000
Lake trout (S. trutta lacustris)	66,000
Charr (S. salvelinus)	719,000
Whitefish (Coregonus)	490,000
Total	4,655,000

Many instances of successful results are reported. Fish culture is in favor with the public, as is shown by the demand for fish planting.

*For this statement we are indebted to Dr. Oscar Nordqvist of Lund.

Of exotic species the American rainbow trout and the American brook trout have been introduced, the former having received greater attention; but results have not yet been reported.

In recent years a good many ponds have been constructed by private parties for the cultivation of carp and tench. For trout culture the principal private establishment is that at Engelsburg, belonging to a private society and devoted mainly to the cultivation of rainbow trout. Complete statistics of these matters are lacking.

In 1897 there was organized a Swedish Fisheries Society, located at Stockholm, where it publishes a journal appearing six times a year, the "Svensk Fiskeritidskrift." In 1906 another society, the Southern Swedish Fisheries Society, has been organized, chiefly for the purpose of founding and conducting an experimental station for fish culture and fisheries in ponds and lakes; for the breeding of fish races of rapid growth and adapted to the climate of southern Sweden; for the founding of a school for fresh water culture. The station is under construction at Aneboda, in the province of Smaland, embracing the fisheries school and about one hundred acres of artificial fish ponds; and besides these ponds the society has rented several small lakes for experiments.

FINLAND.*

In Finland the government engages in fish culture, and the duties connected with the work devolve upon an officer styled the Inspector of Fisheries.

The species artificially propagated are whitefish (Coregonus lavaretus and albula); brown trout, (Salmo fario) American rainbow trout (S. irideus); American brook trout (S. fontinalis); pike, (Esox lucius); roach, (Leuciscus rutilus); and charr, (Salmo salvelinus). The fishes hatched are liberated at various ages, but mostly as fry.

There are two public fish cultural stations, one at Evois and one at Helsingfors. The former is termed an experimental station, and the latter is connected with a Fisheries Museum.

*To Dr. O. Nordqvist we are indebted for the facts about Finland.

From Evois there were distributed in 1905 the following fry:

Coregonus lavaretus	2,200,000
Salmo salar	23,000
S. fario	10,000
S. irideus	448
S. fontinalis	10,000
Esox lucius	10,000
Leuciscus rutilus	2,000

From the establishment at Helsingfors there are generally distributed some thousands of fry of the Ladoga charr, salmon and whitefish.

The planting of Coregonus albula and lavaretus and of the American rainbow trout have given practical results. The rainbow trout is found to thrive well in ponds and in one small lake, but the American bass, large and small mouthed, which have been introduced and planted in various lakes, have never been seen since their liberation.

Of private fish cultural establishments there are known to be three, of which two have been established within the past five years. They handle salmo ferio, Coregonus lavaretus and the American rainbow trout, but only for their private waters.

The Finland Fisheries Society, founded in 1891, publishes a journal "Fiskeritidskrift for Finland," arranges fishery exhibitions, sends out teachers on different fishery topics, etc.

JAPAN.

In addition to the account of fish-cultural and fishery matters in Japan which appeared in the Transactions of the Society for 1904, the Bureau of Fisheries has recently published a very able and instructive report by Prof. K. Mitsukuri, of the Imperial University of Tokyo, on "The Cultivation of Marine and Fresh Water Animals in Japan." It is therefore not incumbent on the committee to devote any special attention to Japan at this time.

Immediately on the conclusion of the peace treaty with Russia, the Japanese government took steps to exploit the valuable fishery resources of Saghalien Island and the Siberian littoral where fishing privileges were secured to the Japanese; and a

resulting very large increase in the value of the fishing industry of Japan may be looked for in a few years.

In 1902 the United States government forwarded to Japan at the request of the British Ambassador at Tokyo a lot of 25,000 brook trout eggs. There were hatched in Japan and the fry were placed in the river that flows from Yumoto to Lake Chuzenji, near Nikko, where they have become well established. Under date of January 22, 1906, Lieut. Colonel C. V. Hume, the British military attache at Tokyo, forwarded a splendid specimen in alcohol and wrote as follows regarding the only Asiatic colony of American *Salvelinus fontinalis*:

"These trout afforded very good sport during the months of May, June and July (1905), and a large number were taken, rather too many I am afraid. They were strong, well-shaped fish, in excellent condition and averaging about one-quarter pound in weight. One of the Japanese fishermen informed me that he had taken one of over a pound, but during the four days I was on the river in June I never saw one approaching that weight. The great bulk of the fish caught were taken by three Japanese fishermen who fished for the hotels at Chuzenji and Yumoto, and I have seen them with baskets of over thirty fish, all taken with rod and line. My best day was twenty. The fish take the fly readily and are not as shy as the brown trout of the British streams to which my trout fishing has hitherto been confined. They are sometimes slow to move and will not take till the fly has been presented to them three or four times. The most killing fly is a somewhat crude one dressed by the native fishermen. They also take, among other flies, the March Brown, the Blue Dun, and the Teal with yellow body. The Japanese fishermen also take them with a bright yellow natural fly and by dipping with a black water caterpillar, both found in the river. A fly-spoon is also useful for the deeper reaches."

CHINA.

Col. James L. Rodgers, a member of the Society and now American consul-general at Shanghai, China, reports that the Chinese government, through all of its multitudinous degrees or branches, does absolutely nothing, so far as he can learn, for fish culture or fish preservation. There are innumerable private

carp pounds and fish ponds in general, but apparently no scientific culture. Yet Chinese are great consumers of fish food and are to Col. Rodgers' mind the most expert fishermen in the world, not even excepting the Japanese; in the deep-sea fisheries, however, they do not appear to be as far advanced as might be expected in view of their proficiency in the lakes, rivers, and canals, where their devices are exceedingly ingenious and very efficient.

During the recent visit of the Imperial Chinese Commissioner to America, our fish cultural and fishery methods were made the subject of special inquiry, with a view to their introduction into China.

BOOK LISTS.*

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A. Holztendorf.—Les eaux à poissons closes du royaume de Saxe.—Dresde.

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G. Ferner.—La pêche à la ligne.—Grethlein, Leipzig.

Travaux de la Station de recherches relatives à la Pêche maritime à Ostende. Fascicule II. Ostende, G. Pots.

Martin, (J. W.).—La pêche du Gardon et du Rotengle.—Bourdon et Benoit, Paris.

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P. Buffault.—Essai sur les eaux et la pêche fluviale dans le departement de l'Aveyron.

E. Lebel.—De la nécessité qu'il y a de rendre l'épandage obligatoire pour les fabriques de sucre et pour les distilleries.—Doal, Péronne.

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Victorin.—Les produits de la mer. Hartleben, Vienne.

Commission permanente pour l'etude des mers.—La peche dans la Baltique a l'epoque actuelle.

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O. von Aufsess.—Les propriétés physiques des lacs. Vieweg, Brunswick.

G. Billard et C. Bruyant.—Sur le röle des algues dans l'épuration des eaux.—Masson, Paris.

G. Antipa.—Les Esturgeons et leurs migrations dans les eaux continentals d'Europe étude particulière des espèces du Danube et de la mer Noire. Bucharest.

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Dr. F. K. Knauer.—Die Tierwelt unserer Suesswasser.—Aquarien.

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S. E. Meek.—The fresh water fishes of Mexico north of the isthmus of Tehuantepec. Field Columbian Museum, Chicago.

The Cambridge Natural History. Vol. VII. Une nouvelle introduction à l'étude de Poissons. Macmillan, London and New York.

E. Von Leyden.—La théorie parasitaire et l'étiologie des écrevisses. Hirschwald, Berlin.

R. Robert.—Les poissons vénéneux et les poisons du poissons. —Enke, Stuttgart.

A. Fedderson.—Agnbogen (Amorces).—Dansk Fiskeri-forenings Kontor, Copenhague.

Voeltzow et Lentz.—Décapodes et Stomatopodes de l'Ouest Africain.—Francfort-sur-le-Mein. Diesterweg.

D. S. Jordon.—A Guide to the Study of Fisheries.—Holt & Co., New York.

PERIODICALS.

Jahrbuch fuer Acquarien und Terrarienfreunde.—Hans Schultze, Dresde.

Bulletin Suisse de Pêche et de Fisciculture. Redacteurs: Savoie-Petitpierre et Prof. Dr. O. Fuhrman, Neuchatel.

Le Pêcheur. Organe des pêcheurs à la ligne et de leur societés.—Ph. Linet, Paris.

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Dansk Fiskeritidende. Medlemsblad for Dansk-Fiskeriforening. Redaktor.

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Revue des Eaux et Forêts, Paris, 13, rue des St. Peres.

Archives d'hydrobiologie et d'Études du plancton.—E. Nagele, Stuttgart.

Annuaire de la flotte danoise de pêche pour 1906.—Christren, Copenhagen.

Station de Pisiculture et d'Hydrobiologie de l'Université de Toulouse. Bulletin pour l'anné 1904.—Privat, Toulouse.

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Near the conclusion of the report Mr. Atkins made the following comments:

In examining the advertising pages of some European journals, especially the German journals, I found large numbers of hatcheries offering eggs and young fish for sale, and I could hardly find one that did not offer either rainbow trout or American brook trout, and the majority of them were offering both. In fact, I think there were more of those advertisements that specified the American fishes than of those that specified the European brook trout. So that at present our American species are great favorites abroad. Some parties in England doubt whether the rainbow trout will be entirely successful, and I suppose for years it will be a matter of uncertainty.

The following discussion was had regarding the Paris hatchery:

Mr. Clark: Mr. Titcomb suggested that questions regarding the raceway might now be considered and noted in the proceedings. I would therefore suggest that the matter be taken up now. Mr. Marks is here, and is, I believe, ready to answer any questions.

Mr. Titcomb: I thought it would be a good thing to get answers to the questions a good many individuals have asked, and I hope the other fish culturists will also ask any that I may omit, so that we may get that matter in the report. I would like first to have Mr. Goodwin put down the recipe for the making of the Lane's food.

Mr. J. P. Marks: Two quarts animal meal with one and one-half pounds of salt put in water and brought to a boil. Then add

a mixture of eight quarts of corn meal and sixteen quarts of wheat middlings. Then cook about five minutes. This material is then put through a plate having perforations, for old yearling trout, three-sixteenths of an inch in diameter; for two year old trout, one quarter of an inch in diameter; and for the larger fish, of five-sixteenths of an inch in diameter; in order to produce the vermicelli-like substance which you have seen. While cooking, the material should be thoroughly stirred. The foregoing is a recipe for Lane's food.

Mr. Titcomb: How often is this food given to the fish and to what extent?

Mr. Marks: We feed it once a week and liver once a week to large fish.

Mr. Titcomb: Do you only feed your fish once a week?

Mr. Marks: Twice a week—that is, large fish—yearlings once a day, and two and three year olds, three times a week.

Mr. Titcomb: The Lane's food?

Mr. Marks: No. We feed the Lane's food once a week to all the fish, except fry and fingerlings.

Mr. Titcomb: Then after the spawning season the larger fish are fed three times a week with this food?

Mr. Marks: Usually right after the spawning season we only feed liver—this food is only given through the summer season—spring and summer.

Mr. Titcomb: And when you feed this food you feed this and the liver alternately once a week?

Mr. Marks: Yes.

Mr. Titcomb: What is the address of the company that makes this food?

Mr. Marks: The Bowker Company, 43 Chatham street, Boston; and 68 Broad street, New York.

Mr. Titcomb: I understand this food is especially useful at stations where you cannot have fresh meat always available, and

can be used as a standby to take care of fish for a week or two in such cases.

Mr. Marks: Yes. Three years ago we fed one or two pound rainbows nothing else than that for three months.

Mr. F. R. Bassett: What do you know regarding the quality of fish when prepared for the table with this animal food compared with liver fed fish wholly?

Mr. Marks: I could not say. Some of these men that use mixtures claim that the fish is improved by them. I do not think there is any doubt but what the mixtures of wheat middlings with any meat food improves the fish.

Mr. Bassett: Would you consider it as fattening as meat?

Mr. Marks: No, I don't think so.

Mr. Titcomb: It keeps your fish in better condition for spawning to have some of this food given them.

Mr. Marks: Yes.

Mr. Clark: I would lke to ask regarding the race, if you don't think that better results would be obtained and double the quantity of fry carried, if you had two sections, each half the length of the present raceway, and having the same flow of water? In other words, double the quantity of water and double your fish by having them in two shorter raceways?

Mr. Marks: Yes, I think better results would be obtained by the method you suggest.

Mr. Titcomb: You would double the capacity of your raceway for the same length?

Mr. Marks: Yes sir. We find a loss at the lower end larger than at the upper end, if the race were shorter with the same volume of water, the lower fish ought to be better.

Mr. Clark: The idea that I have, Mr. President, is that the long trough does not carry fish enough.

Mr. Titcomb: Would you shorten up your intermediate riffle compartment also?

Mr. Clark: No, nothing to amount to anything.

Mr. Brown: You put more fish in each division?

Mr. Clark: More fish would naturally come in each division, and the idea of having the two race ways of 200 feet each is that you could introduce double the quantity of water for the hundred thousand fish, whereas it would not be safe here now, even if there was an ample supply, to introduce it when the fish were young, because the current would be too strong.

Mr. Marks: With the amount of fish we have there now, by fall it will be crowded—the growth of the fish will crowd it.

Mr. Titcomb: With the current which you have, do your fish dash against the screen?

Mr. Marks: This sized fish?

Mr. Titcomb: Yes.

Mr. Marks: No, but putting fry in from the trays it will drive them against the screens.

Mr. Atkins: What proportion of those fish do you expect to die during the season?

Mr. Marks: I do not think we will lose over three or four per cent.

Mr. Atkins: Between now and when?

Mr. Marks: Say between now and September—provided there is no disease.

Mr. Atkins: How do you take out the dead ones?

Mr. Marks: With a scap. When we clean it down the dead ones wash down against the screen and are taken off.

Mr. Atkins: Do you count or keep a record of the dead ones?

Mr. Marks: No, sir.

Mr. Atkins: But you satisfy yourself of the amount of fish after you get through.

Mr. Marks: If we get many dead ones we know there is something wrong.

Mr. Lydell: How do you get your fish out of there finally?

A. It is not very hard.

Q. How is it done?

A. With a small seine.

Mr. Titcomb: Do you take them right up in the seine?

Mr. Marks: Yes, sir.

Mr. Titcomb: I think it would be easy to put below each riffle a flat frame of fine netting, so that they would wash down on it, on the principle of down-stream salmon rack.

Mr. Marks: We take the bulk out with a seine and then take two screens and a scap, and catch the rest, and then move on down and do the same thing. There is no trouble in catching them.

Mr. Atkins: You count those fish that you put in there?

Mr. Marks: Just estimate them—that is all.

Mr. Atkins: And when they are taken out in the fall do you estimate them again?

Mr. Marks: We will count them—at least we did last year, but we don't always count them.

Mr. Lydell: How many fish did you get out of there last year in full?

Mr. Marks: I could not say—I think we had 17,000 brook trout and about 25,000 rainbow.

QUESTIONS FOR THE QUESTION BOX, AMERICAN FISHERIES SOCIETY.

BY JOHN L. LEARY, SUPT., SAN MARCOS STATION, BUREAU OF FISHERIES.

1. Can anyone tell how to distinguish the sex of black bass, with certainty other than by eviscerating?

2. Have artifical nests, after thorough trial, proved satisfactory?

3. Have you ever transferred black bass fry, just after they rise from the nest, to nursery ponds and held until two to four inches long, and with what results?

4. Have you ever stocked up an applicant's pond with black bass fry just after the food-sac has been absorbed, and watched the results?

5. Which do you think gives best results planted in small streams, lakes and ponds, fry or fish?

6. In pond culture have you found it best to impound your fish in small areas, or allow them to nest at will?

7. Do you approve of feeding your brood fish between the seasons of spawning?

8. Do you in your pond work, find it necessary to clean your ponds every season after getting rid of your young fish?

9. Do you find much trouble in handling crappie (the young for distribution) in very warm weather?

NOTE: What I mean by fry is from the time the embryo leaves the egg to the time the food-sac is absorbed, and fish, from the time they are one or more inches long.

DISCUSSION.

Secretary: I would like to say that a conversation I had this morning with Mr. Seymour Bower related to one of these questions and therefore I think it would be important to those who are raising bass, to have some of these questions answered, if not all. The question I refer to was this:

"In pond culture have you found it best to impound your

fish in small areas, or allow them to nest at will?" This is question number 6.

President: We will take up question number 1. "Can anyone tell how to distinguish the sex of black bass with certainty otherwise than by eviscerating?"

Mr. Titcomb: That is answered in Mr. Reighard's paper.

Dr. Birge: It seems to me that most of those questions are pretty well answered in that paper.

Mr. Titcomb: I think that question about impounding the adult fish might be a good one to answer here and have it put into the report. Mr. Leary is talking especially about the large mouth bass, and as far as I know the segregating of the parent fish from the main pond is being discontinued.

Mr. Lydell: We now allow our large mouth bass at the Mill Creek Station, to seek their own spawning nest. We are certain to have plenty of natural spawning ground for them though, but we build no nests for the large mouth bass.

Mr. Titcomb: At the Fish Lake Station, in Washington, we supply the large mouth bass with small piles of gravel scattered around, and they sometimes select them and sometimes they take the weeds. This is a station where the impounding idea was carried on most extensively, and as the apparatus which separates the adult fish from the principal part of the pond rots out, we remove it as not being at all necessary. The cannibalism does not come from the large fish.

Secretary Peabody: Mr. Bower stated to me this morning that he thought the transferring, molesting or changing of the black bass was injurious, but I presume he was referring rather to the small mouth than the large mouth bass perhaps.

Mr. Titcomb: We have ponds like those at Mill Creek; separated by a partition, lattice-work, or net-work, a small portion—one corner. We let the adults spawn in that corner and then the young fish are supposed to have sense enough to go out through these slats into the main pond and separate themselves from the large fish. That method was adopted because I think at the

time the fish culturists thought that the large fish were the ones that ate these small fish, but instead of that the small fish really ate each other. Now we take away those enclosures as fast as they rot out because they are of no advantage.

Mr. Fullerton: You let the parent fish and the small fish go right together?

Mr. Titcomb: Yes—that is for the large mouth bass.

Secretary Peabody: Question number 7 is: "Do you approve of feeding your brood fish between the seasons of spawning?"

Mr. Clark: Certainly.

Secretary Peabody: Question number 8 is: "Do you in your pond work find it necessary to clean your ponds every season after getting rid of your young fish?"

Mr. Lydell: I clean mine if necessary, and if not, I do not. I think a man should use his own judgment in regard to that. If his ponds need cleaning let him cleam them.

Mr. Clark: That has reference either to cleaning out refuse or cleaning it from the last fish. If from the latter, most certainly; and draw them dry if you can.

Secretary Peabody: Question 3 is: "Have you ever transferred black bass fry, just after they rise from the nest, to nursery ponds, and held until two to four inches long, and with what results?"

Mr. Clark: I answered that question at our meeting either yesterday or the day before, when I stated that I had transferred 10,000 fish to a pond, and we counted out 8,325 number two fingerling fish from that number.

Mr. Titcomb: That is the small mouth bass?

Mr. Clark: Yes.

Mr. Lydell: But he speaks of large mouth—there is great difference between transferring large mouth and small mouth bass—there is more loss in the former.

Mr. Fullerton: Do you think that the draining of the ponds after taking the fry out and putting the adult fish in another

pond, would be good policy—that is in a climate like Minnesota, letting the pond remain dry all winter?

Mr. Clark: I am not prepared to state.

Prof. Reighard: It is the practice to do that with the German carp ponds. Exposing the vegetation and the soil in the bottom of the pond to the air helps decay, and the freezing loosens up the soil more or less, so that altogether the method has a tendency to break down the more complicated chemical compounds in the plant material, and make them more available for plant growth the next year. I think Mr. Lydell has had a little experience in that line.

Mr. Lydell: Our ponds were dry from about the first of September until the latter part of November, and our plant life in there did not come on quite as early this season as it has in former years but it is just as abundant now as it is in the other ponds.

While I am talking I would like to ask Dr. Birge or Prof. Reighard in regard to the introduction of foods in our ponds. I noticed that the ponds that were dry the longest last fall were the ponds that produced the most food this spring for fry and young fish, and I was greatly surprised because I supposed that the frost would kill everything, and did not expect anything at all from the ponds whereas I got the most food from them. If it is beneficial I will draw all my ponds dry this fall and leave them dry all winter if it will bring me more food. If it is beneficial to leave them dry during the winter to get daphnia and this food I should like to know it.

Dr. Birge: That is one of the things you have got to try a good many experiments on before you know what is best. But I should say that the exposure of the bottom of the pond to the air, and perhaps to freezing, loosened up the material and put it into a more soluble form, so that when the water came back on it along in the spring there was more rapid growth of the minute organisms on which these feed, and so they had a better chance to develop. It does not seem to me at all unnatural that that should be the case, but I think you want a good many comparisons. This

result is what these carp raisers find in Germany, and I should think the same principle would hold here.

Mr. Clark: Are we to understand that the plant life would grow more abundantly if the ponds were drained as suggested?

Prof. Reighard: That is true of the microscopic life but not of the chara.

Mr. Clark: I was in hopes to have a photograph here to show how abundant the moss is at Northville. Mr. Titcomb asked me to have a picture made of a pond drawn down, showing the moss heaped up preparatory to removal. However, the photograph has not, as yet, been forwarded here.

Dr. Birge: I would not expect drawing a pond down would check chara, but I would not be certain of it.

Mr. Titcomb: Mr. Fullerton raised the question of removing bass from large ponds and placing them in small ponds during the winter. That has been the plan adopted in Washington, and we have experienced no trouble in confining the adult fish in small ponds through the winter, and have kept our large ponds dry, thinking it was better for them for the reason Dr. Reighard has stated, and in hopes that there was less luxuriant growth of plant life as a result. We have a superabundance of aquatic plants—and it is to eradicate them.

Prof. Reighard: When the daphnia and other crustacea begin to grow in the ponds they increase very rapidly for a certain time and then they diminish. It is possible that by using the ponds in a certain rotation one might keep up the supply of crustacea for a much longer time than by flooding them all at one time. The water might be turned into a pond, and when the food has appeared there, might be used for the fry and subsequently the water might be turned into another pond and so on.

THE CARE AND FEEDING OF FRY IN POND LIFE.

SENT IN BY F. M. JOHNSON, M. D., BOSTON.

Mr. President and Gentlemen: A salient point for first consideration is the preparation of the ponds. There should be many places where the water is shallow and its force is slow, other nooks where there is abundant shade, again where the waters deepen, especially where the current is marked large boulders should be thrown, providing resting places and safe hiding corners for the tiny forms of life, we are all so interested in. As all good ponds should be fed by a brook, its course ought to receive special attention. Many fairly deep pools can be artificially made by the careful adjustment of stones, and of small dams.

If we follow out the natural lines it is an easy task to enhance their natural inclinations. If the stream admits of a bridge, one or more, then place them where they will be of value.

It is my pleasure to see each summer that my brooks are as perfect as I can make them, all old rubbish that alone blocks the stream should be removed, a clean white sand at the bottom of the brook is the thing to be desired. When the pond is reached, it is a wise procedure to clean it of all old and odd stuff that may have been thrown into it. Then to control the current of the brook so it will take the desired direction.

The growth of bull-rushes and water grasses should be encouraged and aided, for among the shielding leaves, shade and protection are given. Old stumps of trees should be allowed to remain where they are, all smaller streams that empty into the pond might be aided by removing all clogging to the minute streams that add food and oxygen to the pond waters. The white lilies I favor if they are not allowed to multiply too rapidly. The dams should be perfect in construction and the wire netting kept clean.

Let us now suppose that these details have been carried out and the fry is ready for the new home. How and where should they be placed? Never in my opinion ought they to be poured

from the can in any one especial place. No matter how tempting this particular locality appears. Always a few should be dipped from the can and distributed along the shores of the pond and in the places by the brookside prepared for them. They now soon learn to care for themselves. When the fry is very small no attempt should be made to feed them for there ought to be a good and sufficient supply in the waters of the brook and pond. A little later small schools of fry will be discovered at different localized areas, and then feeding can be begun. If angle worms are chopped up into small pieces, they make the very best food possible and a natural one.

Of course this would be impossible where there might be many ponds or one pond that covered too much territory, but in a medium sized pond, it is not at all difficult. The luscious denizen of the world below the grasses may not be easy to obtain and the next food that has marked value is buttermilk. With this all that is necessary is to pour a little of it in the water where the fish are seen and they do the rest, or the finely ground up liver can be used. With liver perfect freshness is absolutely necessary for the slightest taint and the delicate children die of intestinal disturbances. As the fry gain in size and strength, they begin to be fingerlings and better able to take the foods mentioned when not in quite such a finely mashed up condition.

Well cooked vermicelli is now greedily snapped up and if not given too often is most excellent. Ordinary cheese in very small pieces never reaches the bottom and is swallowed most readily. A piece of meat suspended over the stream will in a short time give a good supply of maggots and these seem to be devoured quickly. Food of any kind should be thrown in small quantities so it can be seized and not fall to the bottom. Salt ought to be added to the foods now and then. Ordinary milk curd made with milk and Fairchild's pepsin, and squeezed out through a piece of gauze, is another food, easily digested by the fry, and readily prepared. The yolk of hard-boiled eggs, mixed with a little salt and strained through a fine meshed seive, makes a change in diet that is appreciated. Once a week at least, if the waters are not stirred up by the rain, they should be stirred up by wading about in them, so that for several hours, they become markedly muddy. Into the waters salt should be thrown once

in ten days or a fortnight. By these measures, I feel sure I have raised fry and very small fingerlings, that looked when I received them as being in bad condition, sickly and with fins frayed, to beautful fish who survived the winters of cold, and are today as perfect specimens as could be desired. To these few conclusions and applicable alone to the small ponds I would, gentlemen, call your attention.

1. Fry should never be distributed en masse, but always a few at a time and the localities chosen.

2. Cut up worms, buttermilk, maggots, milk curd, cheese, hard boiled eggs, vermicelli, and finely minced liver are all good foods.

3. The preparation of the pond and brook is a prime necessity.

4. Fry are apt to be handled too carelessly. They are extremely delicate, and should receive extreme attention.

I thank you, gentlemen, for your courtesy.

THE FISHWAY AT GRAND LAKE STREAM.

SENT IN BY W. O. BUCK.

This is in some respects a new departure.

It is here definitely described partly for this reason and also for the purpose of directing attention to conditions which may well exist elsewhere and which should be carefully considered by fish culturists and met in some way wherever found. Let these be stated first.

THE LOCALITY.

Grand Lake Stream is the outlet of a large lake at the head of the west branch of the St. Croix River in eastern Maine. This lake is well stocked with a small variety of landlocked salmon. It has been asserted that all the adult salmon in the lake come to this stream to spawn, and conclusive proof to the contrary is yet wanting. The stream is a rapid one and for two miles below the dam contains many gravel beds suitable for ridds. Above the dam and within one hundred yards of it is a gravel bed which suits the fish when the water is low enough in the lake and the gates in the dam are opened enough to give sufficient current. The management of the dam for many years has met these conditions and the fishing for spawning purposes has been carried on by placing a barrier net across the river just above this gravel and then setting a trap for fish trying to reach it from the lake. If such a barrier could be maintained throughout the year and fish thus be kept from passing down through the dam, all spawners coming to the stream from the lake could be captured at the spawning season. But this barrier is maintained only from September 15 until a short time after spawning is over, about December 1. While the fish doubtless seek the stream in greater numbers at this season, they will also run down over the dam at other times.

THE DAM.

The dam has for long been in such a condition that fish could pass it only downward and could not safely do that except in a

comparatively high stage of water. The leaky aprons wasted water so fast that they became a trap for fish somewhat after the manner of an Indian eel-basket. Fish allowing themselves to float down through the gate were likely to be caught in cracks or stranded on the plank. As little or no water flowed over the lower end of the aprons which were close to or above the surface of the stream, no fish could pass up.

As now rebuilt, however, the dam is twelve feet high and maintained for storage of water to be used in driving logs through the stream and also as a reserve for supplying water for power to mills lower down the St. Croix. The gates are therefore closed during a considerable part of the year and the stream then becomes a small brook with most of its spawning gravels laid bare. During the driving season, on the contrary, the gates are opened and the stream is a river, broad, deep and swift, while the logs are being sent through, to become a brook again when for any reason the gates are closed. In case of a jam of logs and sometimes for other reasons the gates are all closed suddenly and fish are then very liable to be stranded in little pools where they must die as the water drains away. In fall, when water is needed for the mills, the gates are opened and fish on the stream to spawn find just the conditions they want on the gravels. Later in the winter the gates are closed to let the lake fill, the gravels are again laid bare and eggs deposited there are of course destroyed. As thus managed the stream is evidently a poor place for fish, young or old, and the problem is either to modify the management or get the fish off the stream. Each gate in the dam as now built is in too sections; a top part to be lifted when the water is high and a bottom part three and a half feet high, which may also be raised at a lower stage of water. During the high water this three and a half fall over the lower part of the gate upon an apron forms a complete barrier to fish passing up but none, of course, to their going down. And this period of high water will be from early spring until fall. Perhaps it may prove unnecessary to raise the lower sections of the gates at all, in which case the barrier is permanent. To be sure of getting the salmon up over the dam then, they must be carried or a fishway must be provided through which they can swim up. An effort was made the past fall (1905) to trap and net fish on the stream and carry

them above the dam and more than 1,000 were so carried up. This, however, was discontinued at the end of the spawning work of the station. To help fish left on the stream, or which might reach it later, the present fishway was devised. This was intended to help them in two ways. First, by providing a passage through which they might go to the lake if they chose and secondly, by securing a constant, even if small, stream in which they might live though all the gates in the dam should be closed. To provide such a stream is necessary because some fish, even if only the very young, will elect to stay in the stream. The fishway as built consists of a straight flume about seven feet wide and fifty feet long, divided into eighteen pools by partitions reaching from side to side and from top to bottom. In these partitions openings eight inches high and two feet long are made at a height of ten inches above the bottom. At the lower end the opening is at the bottom and also at the upper end, and, since the bottom of the flume is nearly level in its upper part, severed of the upper openings are nearer to the bottom than ten inches. This arrangement at the upper end is necessary because at low water in the lake only a few inches in depth enters the fishway and all openings in the partitions must be low enough to allow this to pass. It is for this reason too that the openings are raised above the bottom in the steeper part of the fishway and are placed on alternate sides of the flume, since, when so little water enters, the pools are not filled and the fishway becomes of the former shallow pool sort.

Four of the pools are above the line of the gates in the dam, i. e., extend up into the lake and their sides, of course, reach to the whole height of the dam. Just below the gate the sides of the flume are some two feet lower than above and thence slope down to the level of a full stream at the lower end. As thus built the pools fill to such a height that the total fall from lake to stream is divided into as many steps as there are partitions. The force of water at any opening is therefore not too great for fish to swin against and the water in all the pools is unbroken and of sufficient depth to provide resting places for fish while in them. Such resting places they will find either at the side or above or below the openings, since eddies or nearly still water are to be found at all such points. Apparently fish will find no

difficulty in passing either up or down through this fishway at any stage of water. And again the volume which will pass an opening eight inches high and two feet wide, even under a small head is sufficient to enable fish to find it and as the outlet of the fishway is at the bottom and only twelve feet down stream from the end of the apron of the dam it is easily accessible. In conclusion, however, be it said that the fish have not yet expressed themselves as to the acceptability of the fishway and theirs is the decisive vote. When they come to the dam this fall it is hoped to learn their view of the question. Meanwhile the fishway is open for consideration and incidentally for passage of a considerable amount of water to supply the stream below when other sources are scanty.

LIST OF MEMBERS.

ACTIVE.

Ainsworth, C. E., *Sault St. Marie, Mich.*
Ainsworth, G. G., *United States Bureau of Fisheries, Leadville, Col.*
Allen, G. R., *Roxbury, Vt.*
Alexander, A. B., *United States Bureau of Fisheries, Washington, D. C.*
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American Fish Culture Co., *Carolina, R. I.*
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Bailey, Nelson, *Wells River, Vt.*
Baldwin, O. N., *United States Bureau of Fisheries, San Marcos. Tex.*
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Barbour, Charles, *Museum of Comparative Zoology, Cambridge, Mass.*
Bartlett, Dr. S. P., *Quincy, Ill.*
Bastedo, S. T., *Toronto, Can.*
Beaman, Hon. D. C., *Boston Building, Denver, Col.*
Beeman, Henry W., *New Preston, Conn.*
Bean, Barton A., *United States National Museum, Washington, D. C.*
Bean, Hon. Tarleton H., *Capitol, Albany, N. Y.*

Beardsley, A. E., *Greeley, Col.*
Beeson, W. E., *care of Foster, Stevens & Co., Grand Rapids, Mich.*
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The Governors of the Several States.

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RECAPITULATION.

Active	387
Honorary	70
Corresponding	16
Total Membership	473

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this society. In case members do not pay their fees, which shall be two dollars per year, after the first year and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice

President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussion of same.
   (Note—a. In the reading of papers preference shall be given to the members present.
   b. The President and two Secretaries are empowered to arrange the papers of the meetings of this Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.